MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

Volume 8 **DECEMBER, 1936** **Number 12**

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Published Monthly at
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Cleveland, Ohio

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New York . . . . 220 Broadway
Chicago . . . Peoples Gas Building
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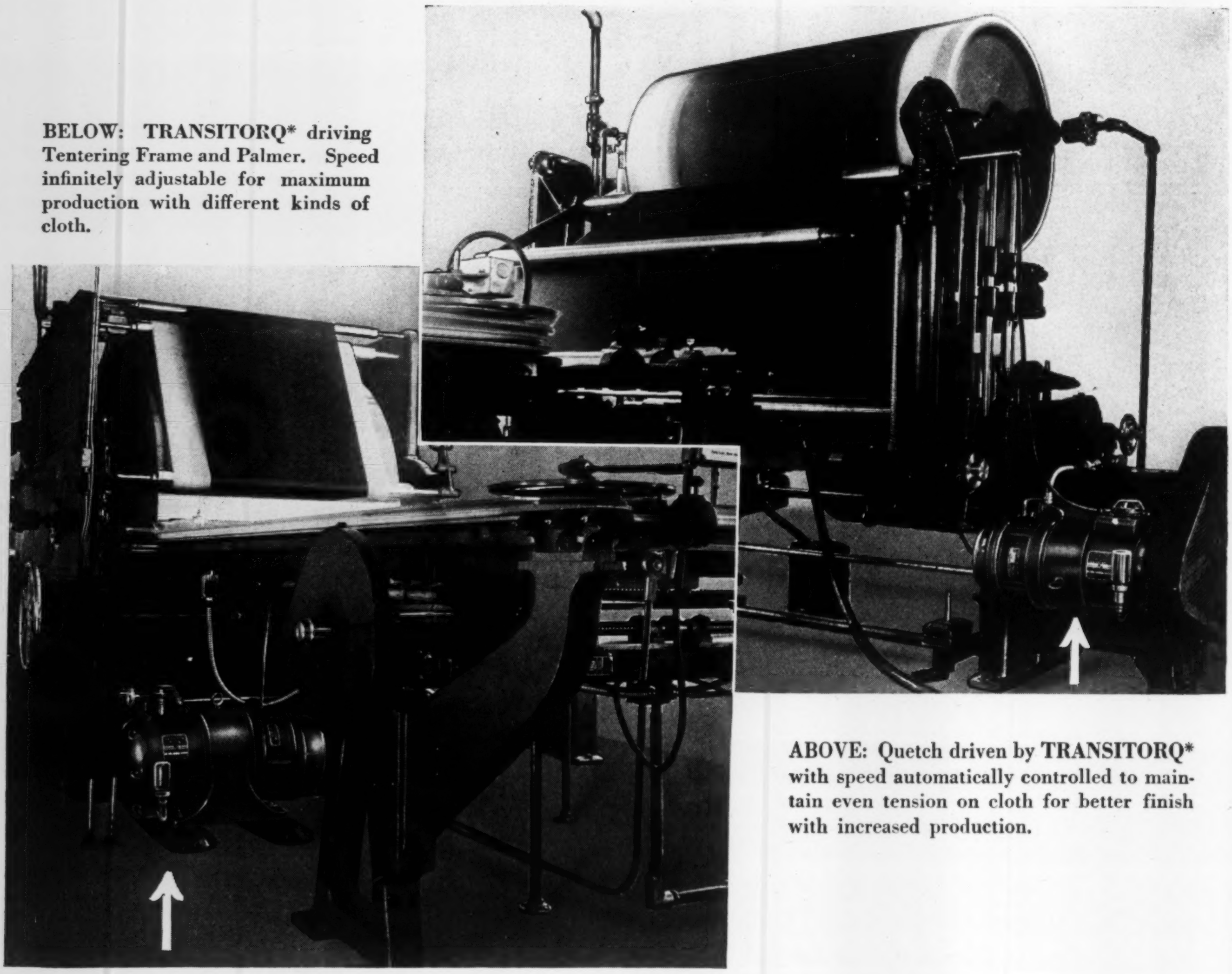
MACHINE DESIGN is published on the tenth of each month. Subscription rates: United States and possessions, Cuba and Mexico, two years $5; one year $3. Single copies 35 cents. Canada, one year $4.80, including duty. Great Britain and other European countries, two years £1.13.6; one year £1.00. **Copyright, 1936, by Penton Publishing Co.** **Acceptance under act of June 5, 1934, authorized July 20, 1934.**



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STUDYING SPECIFIC DESIGN PROBLEMS

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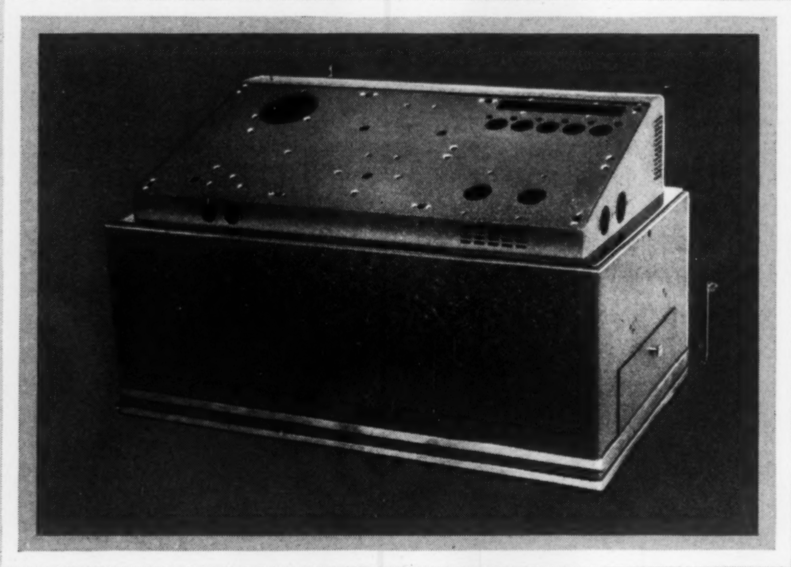

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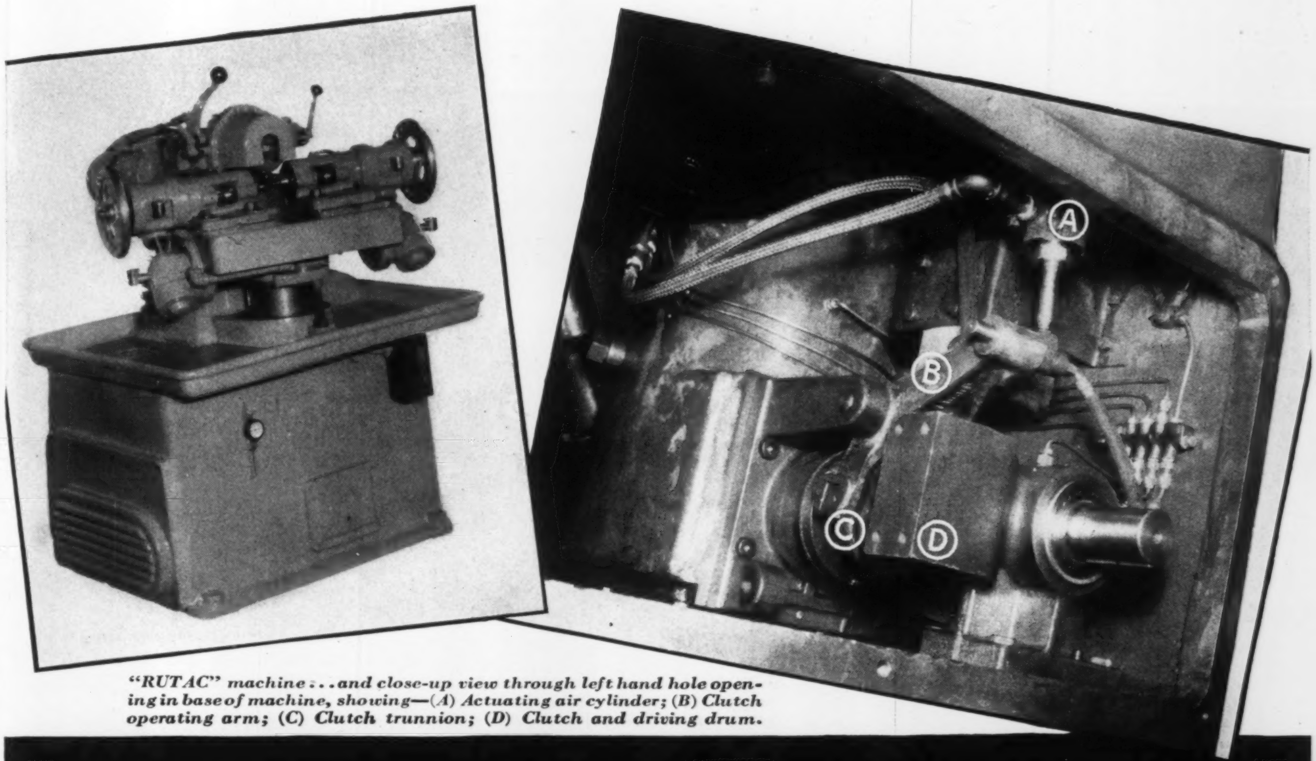
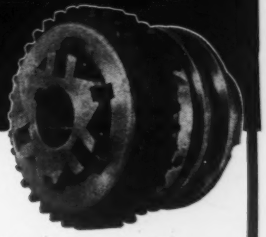


"RUTAC" machine . . . and close-up view through left hand hole opening in base of machine, showing—(A) Actuating air cylinder; (B) Clutch operating arm; (C) Clutch trunnion; (D) Clutch and driving drum.

AUTOMATIC STOPPING.... SAFE HANDLING

Increase Production



The "RUTAC" is a new machine recently brought out by W. C. Lipe, Inc., of Syracuse, N. Y. It is used for chamfering the acute angle at the ends of the teeth of helical, spiral, and bevel gears and pinions, and the sharp corners of the ends of spur gear teeth.

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Topics . . .

GREATER attention should be given to the dimensions, the applications and the characteristics of the machine's prime mover, the motor, to the end that wherever practical standard electrical apparatus may be specified. Such a course affords the user of the machine the maximum in reliability, interchangeability and value. These recommendations, as made by J. L. Hamilton, Century Electric Co., as chairman of the NEMA motor and generator section, are of especial value at this time when the designer is apt to seek something special in the way of dimensions or characteristics when the standard motors would be quite competent for the job. Mr. Hamilton stated, "We should not overlook the very important point of accessibility, serviceability and the use of standardized electrical equipment in our zeal for compactness and for styling of machines—as desirable as these features may be in themselves.

◆ ◆ ◆

Keeping abreast of new developments has become one of the major portions of a designer's job. Each division of the design industry helps every other division by perfecting major ideas and details that immeasurably improve machines for an entirely different type of work. As an example, the high speed operation of automobiles tends to develop carburetion troubles. As an answer, the Stromberg aviation-type carburetor is being adapted to automobiles. The fuel chamber surrounds the entire body, holding gas at a constant level, and inbuilt baffles help control surging on sudden turns.

◆ ◆ ◆

Every year about this time we take a day off from the field of MACHINE DESIGN to don a disguise and roam around the toy towns of the department stores—but we can't get away from machines as toys are yearly becoming more complex and are regularly incorporating more machine principles. In a new railroad set (Hope somebody gives us one) an electric eye enables the boy to control a tiny locomotive with a wave of the hand. A gun molded from phenolic plastics reproduces the original so well that we almost ran, but it shoots harmless rods. And there is available a zinc die cast micrometer so true to the original that already some clever boys have pawned them at about twice their original purchase price. When you can fool a pawnbroker you are really the tops.

◆ ◆ ◆

Christmas also brings out many new machines and devices which are mostly in the domestic field, yet true examples of the machine designer's art. The interesting Hoover sweeper was covered in the November issue of MACHINE DESIGN and is an example of this type of development. In addition, there are many smaller units that required just as much care in their design. One of these is an electric time meter with a Durez case which you can use for timing your three-minute eggs, for use in the sickroom or for regulating little Audrey's practice period on the piano.

◆ ◆ ◆

According to Walter Dorwin Teague the machine tool has unconsciously led the way in the development of functional beauty. This authority believes that insofar as modern machine tools are far more beautiful than their earlier prototypes, they are also more adapted to the functions they are designed to perform, since it was the improvement in the functional value that brought about the better appearance. While machine tools have undoubtedly pointed the trail in the industrial machine field, we believe that the many machines used in the home and in the office should be given their due share of credit, while the one type of machine that has pointed toward improved appearance for years is the automobile. There are hundreds and even thousands of different types of machines, all of which are today tending toward improved appearance. While the readers of this publication wouldn't be caught inside of a beauty parlor, still these establishments are important buyers of machines. And there are many other industries, some of which most of us never even hear of, that are important factors in development of new and better machines.

MACHINE
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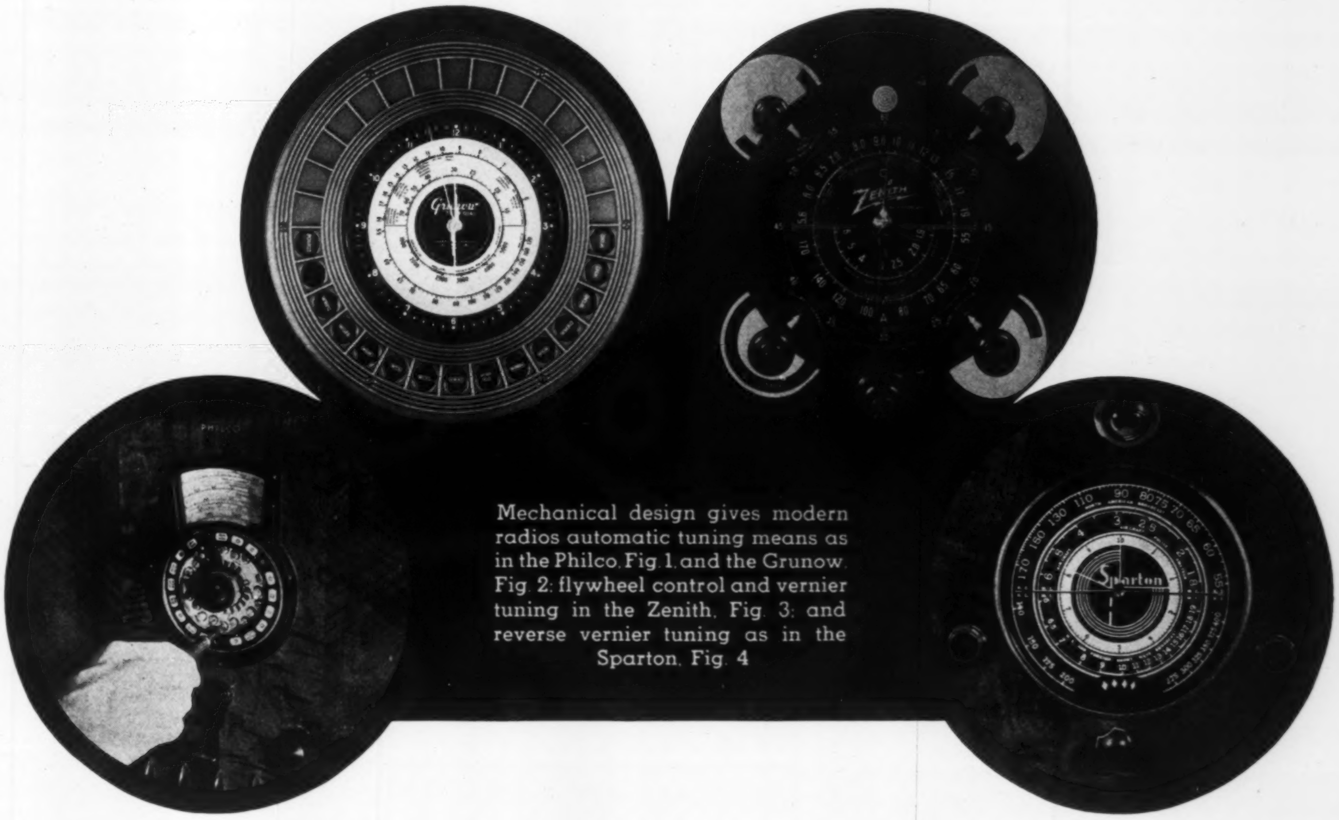


Mechanical design gives modern radios automatic tuning means as in the Philco, Fig. 1, and the Grunow, Fig. 2; flywheel control and vernier tuning in the Zenith, Fig. 3; and reverse vernier tuning as in the Sparton, Fig. 4

Mechanical Design Perfects Radio Operation

By Allen F. Clark

RADIOS, a virtual requirement in every home, today require the careful attention of the mechanical designer. Though originally considered as electrical devices, they have for some time warranted the classification of machines. Stampings, castings, vibrationless mountings, belts and shafting, all subjects of study by the machine designer, have for years been an integral part of every radio. Now their design includes, in addition to these parts, cases and dials of plastic material, gears, overrunning clutches, bearings, spring-actuated devices, vernier controls and many other mechanisms and parts designed to improve the ease and accuracy of operation by the layman.

Plastic cases have been the natural outgrowth of the tremendous improvements made in these materials and their use for the cases of many types of machines. New mechanisms have been necessitated by the development of short wave receivers and the user's demand for convenient tuning means. The current trend is toward the provision of means whereby the person tuning in can locate his favorite station quickly and easily, and toward the simplifying of tuning and logging stations which come so close together on the dial (short-wave) that they ordinarily cannot be separated or found without considerable difficulty.

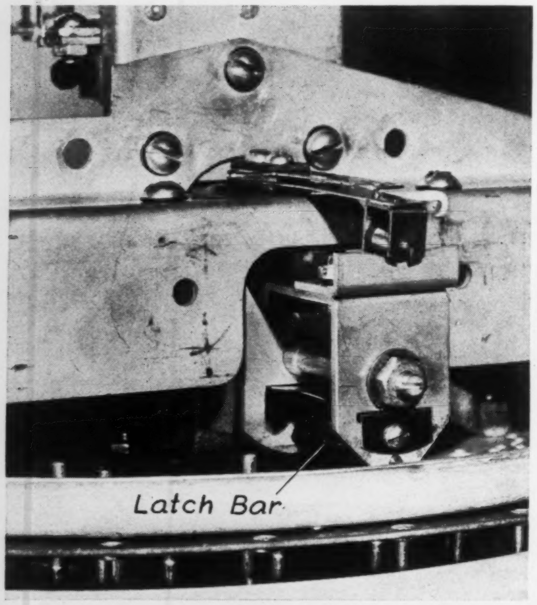
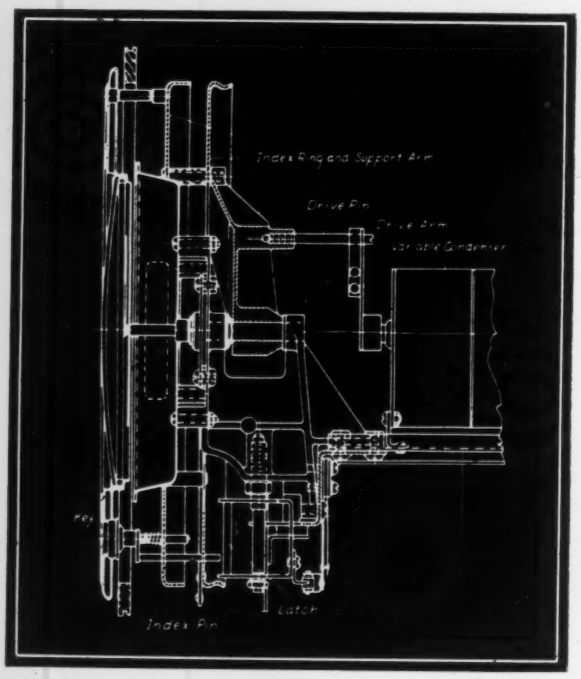


Fig. 5—This plan view of latch shows switch for automatic frequency control

Fig. 6—Index pins contacting the latch stop Grunow condensers at proper point



Simplified tuning of stations popular with the user is exemplified by the new Grunow "Teledial" radio, the dial of which is shown in *Fig.* 2. The object of this design is to permit the user to tune in any one of fifteen selected stations without recourse to a manual tuning device which might or might not bring in the broadcast program clearly, depending on the users' ability. The solution was the adoption of an automatic tuning mechanism. As might be expected, this mechanical arrangement merely turns the variable condensers to adjust them to the proper position for receiving the broadcast of a particular station, the usual method of tuning. But, with the new tuning device this adjustment is made practically without thought on the part of the user, without the necessity of "jockeying" the position to insure exactly correct positioning, and as easily as one dials a single numeral on the telephone.

With the use of an automatic frequency control type of circuit, to be discussed more fully later in this article, all that is necessary with the mechanical design is to set the condensers near the proper tuning point and the desired station automatically "snaps in," result in tone quality that cannot be improved by further adjustment of the tuning device. This type of control is an important factor in several of this year's radios.

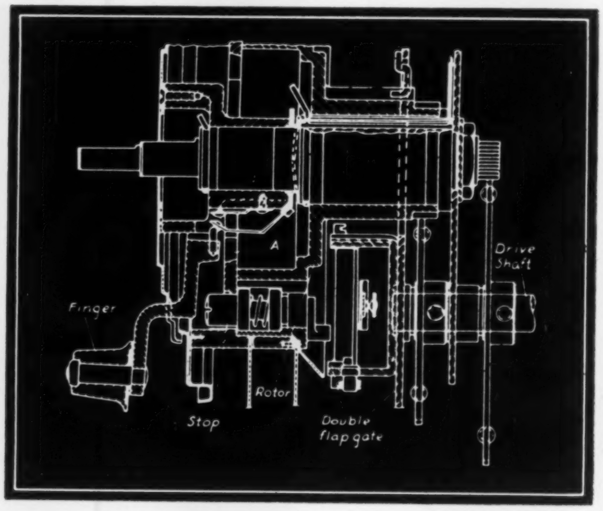


Fig. 7—Automatic station finder of Philco utilizes crankarms for locating the stations

The co-operating mechanical controls for the Grunow are shown in *Fig.* 6. The selection keys, seen on the front of the dial, *Fig.* 2, include index pins, *Fig.* 6, which on rotation contact the latch shown. A top view of this latch is shown in *Fig.* 5. Each of the index pins may be set at thirteen different points, each point on a different radial line in relation to the center of the dial, thus giving a different setting for the condensers. The holes for these settings can be seen in *Fig.* 10. With the set tuned exactly to the desired station, there will be a hole at the bottom of the dial which almost completely uncovers the bar of the latches shown at the bottom of *Fig.* 11. With the index pin through this hole, it is obvious that every time the proper key is depressed and the dial rotated, the pin will contact this latch bar and stop the rotation. When the keys are not depressed, the pins clear the bar. Thus, after the proper setting, the station can again be found by a simple rotation of the dial with the key depressed. The automatic frequency control, previously mentioned, takes care of minor inaccuracies in setting, occasioned by need for infinitesimal spacing of holes to get exact positioning over the bar at each setting, and the station comes in accurately.

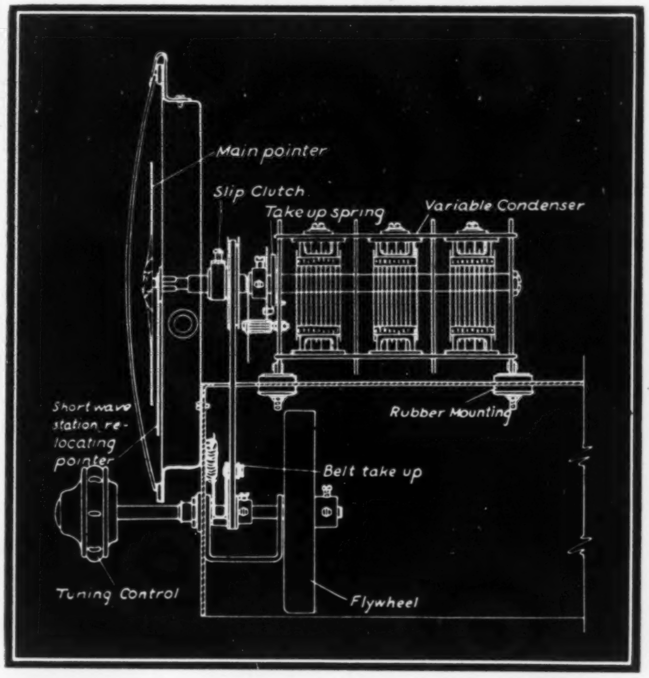


Fig. 8—Flywheel speeds dialing even with large gear reduction in the Zenith vernier control

Action of the automatic frequency circuit is controlled by a switch on the latch itself. When an index pin contacts the latch bar, *Fig.* 6 (this being a plan view) the latch swings to one side. As this action takes place, a cam on the back of the latch brings together switch contacts which place the circuit in operation to exactly tune the radio.

A refinement in this mechanism is the provision of means to "cut out" all intermediate stations when dialing for a new station. This is done by means of an auxiliary switch, the contact strip for which can be seen behind the keys in *Fig.* 10. When a key is depressed intermediate noise is cut out until the spring behind the key releases it when tuning is completed.

This type of control is designed primarily for the tuning of a comparatively few selected stations. Naturally the set user will also want precise tuning of other standard broadcast stations and short wave stations. Steps have also been taken to provide this tuning, during which the automatic frequency circuit is not in operation. A description of the vernier tuning as used on this set will be presented later in this article, but let us first consider another method of selecting preferred stations.

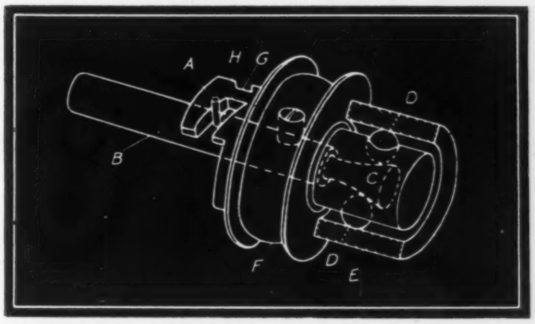
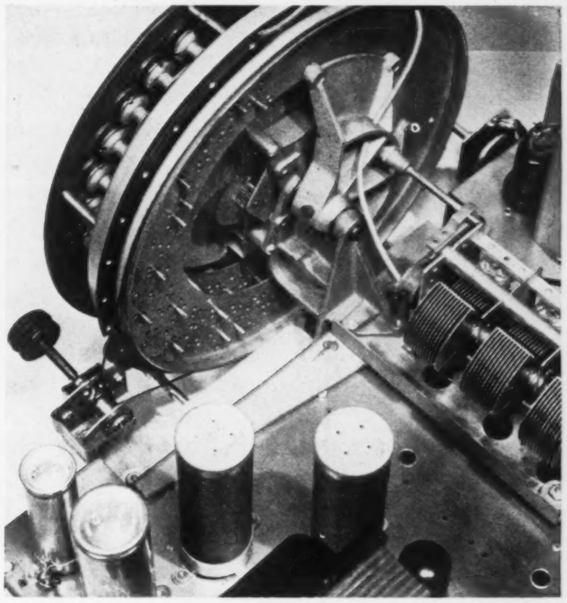


Fig. 9—Reversal of turning gives vernier action with this Sparton dial unit

Fig. 10—Numerous holes enable setting of index pins to exact position



Stops Contact Double-Flap Gate

The Philco automatic tuning system, *Fig.* 7, is made up of a rotor which turns loosely on the manual control shaft, and which carries nineteen depressible stop members (controlling a like number of stations), a double-flap gate against which the selected stop comes in contact in operation, a "mechanical finger" for selecting and depressing the selected stop and for turning the driveshaft, and miscellaneous switches and other apparatus. The rotor is geared to the condenser driveshaft through anti-backlash gears. In operation, the listener moves the freely-rotating finger to the position over the stop corresponding to the station to which he wishes to listen. This finger is also shown in *Fig.* 1. He pushes in the finger which causes it to engage the rotor at *A* in *Fig.* 7, and which depresses the stop, bringing it into operable position. He then swings the finger around until the stop locks in the gate, which operation turns the condenser (through the rotor gearing) to the required angular position. When the finger is released, the depressed stop moves out of mesh with the gate and the dial may then be rotated automatically or manually for other stations.

Switch Deadens the Set

During the tuning operation several other actions take place. As the mechanical finger is depressed it operates a switch which cuts out the audio amplifier and thus deadens the set. As the stop engages the gate, another control circuit is momentarily operated which through an electrical delay sets in operation the electrical system and thus provides the precise tuning of the receiver after the dial system has approximately tuned it. When the finger is released the audio system is re-energized.

Each depressible stop member is in the form of a headed shaft carrying a small crankarm which may be swung through a semicircle to enable adjustment of the stop with respect to the rotor. The stop shaft is prevented from turning with respect to the rotor by gear teeth (not shown) on the shaft which engage corresponding serrations in the rotor. To adjust the stop it is moved inward until the teeth are disengaged, in which position it is free to turn. To provide adequate band coverage the several stop members are staggered with respect to each other.

Stop Is Locked in the Flap Gate

The flap gates are normally free of the stop members, but in the depressed condition the stop rides on one of the flaps, depressing it until the stop is between the two gates, at which position the depressed gate swings forward and locks the stop between the two. The gates are pivoted about an axis in the plane of their front position so that the gap narrows as the gate closes, thus enabling accurate locating of the stop position. Movement of the gate performs one switching operation, movement of the finger another.

Automatic frequency control, mentioned in the foregoing, is brought about by monitoring the intermediate frequency of a superhetrodyne receiver by means of a "Discriminator." This discriminator is designed in such a way that it automatically applies voltages to a correcting device or circuit which results in the oscillator frequency being changed in the proper sense and in the proper degree to substantially compensate for inaccuracies in the manual tuning of the receiver. In other words, if the tuning device of a receiver is brought to within a few kilocycles of the proper setting for exact resonance for the desired station, the discriminator plus the correcting device automatically adjusts the frequency of the superhetrodyne oscillator so that the resulting hetrodyne frequency is made the same as that to which the intermediate frequency transformers are tuned. Putting it more simply, all that is necessary is to get near the proper tuning point and the desired station automatically "snaps in."

The foregoing has been concerned with overcoming the problem of enabling the simple selection of stations heard frequently. Another problem, mentioned in the introduction of this article, is the provision of vernier tuning means for exactly locating stations for ready reference at another time, particularly stations in the crowded short wave band. With the old tuning indicators it was impossible to indicate and separate, locate and relocate short wave stations. The mechanical band spread method as developed for the Zenith radio for simplifying this tuning is shown in *Fig.* 3.

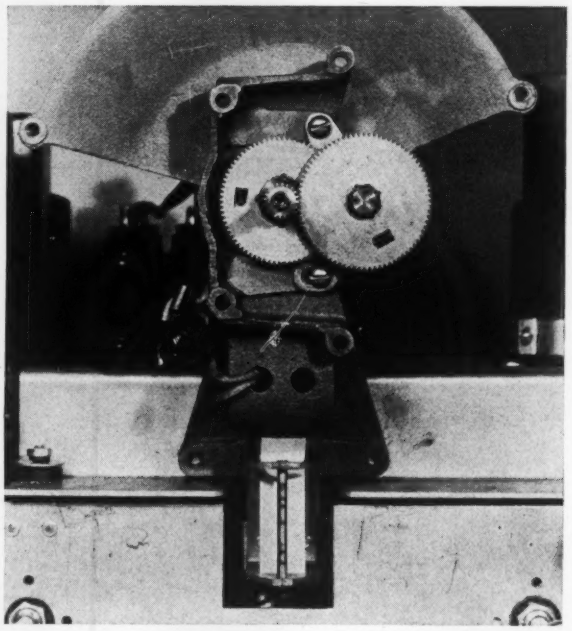


Fig. 11—Gear reduction units such as these are incorporated in many of the recently designed radios

The tuning in of short wave stations is now a very simple procedure. If one wants to tune Germany in the 25 meter band for instance, the main pointer is set to where it reads 25 meters. Now the tuning control is slowly turned. In most cases one will run over the signal and back and forth tuning is necessary. After the station has been tuned in, the location of the secondary pointer is read on the outside scale which reads from 0 to 60. After once recording that Germany is received in the 25 meter band at 17 on the outside scale, one can go back at this setting and without fail receive Germany if the particular station is on the air.

This simple tuning is made possible by a precisely built mechanism, *Fig.* 8. One of the problems in the design was to remove the backlash out of the gear train. This is accomplished by a spiral take-up spring. It also was desirable to have a tuning ratio from 100 to 1 between the tuning control and the main indicating pointer, enabling vernier tuning. This ratio would make tuning from one end of the dial to the other very slow and tedious. The flywheel solved this problem and by spinning the control the pointer travelling time is cut to a minimum. It is now possible to tune very slowly where desired, but also to go over the dial at a high rate of speed. A slip clutch in the mechanism eliminates the chance of any starting strains, while a spring take-up on the belt maintains proper tension. Rubber mounting prevents vibrations from being transmitted from the instrument as a whole to the condensers and thus possibly jarring the set out of correct tuning position.

Vernier tuning is also given an important role in the Sparton radio, in which a planetary mechanism, *Fig.* 9, provides the precise action. In this device the condenser driving pulley, *F*, connected by belt to the condenser shaft, has as an integral part the cage shown to the left. It is obvious that when pin *A* in shaft *B* reaches either face *H* or face *G* of the cage the motion of *B* is transmitted direct to pulley *F* giving a 1 to 1 ratio, or fast rotation of the indicating pointers. The listener can use this ratio to find the desired station, and in finding it he usually overshoots the correct setting. Shaft *B* is then reversed and planetary action reduces the speed of pulley *F* to approximately 17 to 1 for one complete turn. That is, from the time pin *A* goes from groove end *H* to groove end *G*. The slant of the grooves changes the relation of balls *D* to race *C* in order to give a smooth change from planetary action to direct action. Collar *E* is fastened to a bracket on the dial frame.

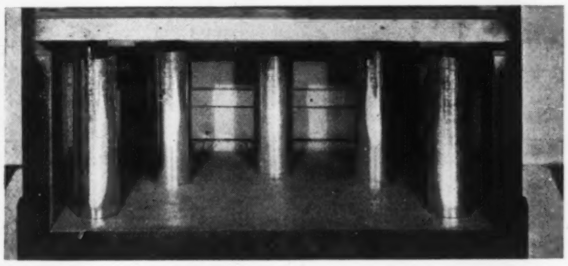


Fig. 12—Undesirable cabinet acoustics can be eliminated by the use of tube baffles such as this RCA Victor arrangement

This Sparton unit *Fig.* 4 corresponds with the Zenith *Fig.* 3 and the Grunow *Fig.* 2 providing a closely divided extra dial for accurate logging of stations. The higher speed of the extra pointer necessary to produce one revolution while the standard pointer covers one division, is, of course, provided by gearing. In the Zenith, *Fig.* 8, this gearing provides the high ratio tuning as noted in the foregoing. The Grunow also provides this high ratio tuning by the gears shown in *Fig.* 5, of the anti-backlash type. In the regular tuning of this later set, without the use of the automatic station finder, the dial is turned through a rope belt seen in *Fig.* 10. The tuning control is further refined by the use of ball bearings on the tuning shaft, lower left of *Fig.* 10.

Mechanisms Are Concentrically Located

In the Philco arrangement of *Fig.* 7 the manual and dial mechanisms are concentrically located but independently geared to the condenser driveshaft to provide the proper gear ratio. A flexible coupling to the condenser is provided to prevent cabinet vibrations from being transmitted to it. The vernier manual control comprises a shaft inside and concentric of the manual control shaft and geared to it through a ball race system giving a speed reduction of about 10 to 1. In this set accurate logging is made possible by a hairline indicator for the manual dial scale. To focus the light from a pilot lamp and bring it to a sharp bright line image, a cylindrical lens consisting of a plain glass rod is used. The lens is stopped with translucent material so that the aperture is about equal to the rod radius. Under these conditions light through the lens comes to a sharp line focus about the radius of the rod in front of it.

Includes Acoustical Filters

Another problem which must be overcome when designing radios, and one of the most difficult problems which has faced the radio engineer since the inception of radio broadcasting has been that of radio cabinet acoustics. The development of the RCA Victor "Magic Voice" now permits a simple analytical solution of this problem. This has been accomplished by the reduction of acoustical impedances of the system to their equivalent electrical network. Expressed briefly, the back of that portion of the cabinet housing the loudspeaker is closed and the sound from the rear of the cone is permitted to pass out of this enclosed space only through a properly designed acoustic filter. The metal pipes shown in *Fig.* 12 constitute this filter system. As in the case of an electrical filter, it is possible to so design this acoustic filter that the sound waves are reversed in phase as they emerge from the bottom of the cabinet. Thus they are in phase with the waves from the front of the cone and the effect of an infinite baffle is approached. Actually, it is found that the normal sized console, when equipped in this way, can be made the equivalent of a baffle eleven feet on each side.

Despite the advances shown by these interesting mechanisms, the mechanical development of tuning devices is a rather young art. Many new developments can be expected in the future. The mechanical designer is assuming an ever increasing importance in these developments.

SCANNING THE FIELD FOR IDEAS

ELECTRIC signals from tank to dash board are employed in the King-Seeley automobile gasoline gage, of which operating diagrams appear herewith as *Fig.* 1.

This telegage system embodies two principal units—the "tank sender" and the "dash receiver," the two being connected by electrical cable. When the tank is empty the two contacts in the tank sender are just touching. With the ignition switch on, current flows through the circuit, warming up the heater coil and causing the bimetal element to bend. This bending action in the tank sender opens the contact and breaks the circuit. Then the bimetal element cools and returns to its original position—this cycle being repeated automatically about once every second. While this is going on in the sender, similar action is being reproduced in the dash receiver whose coil is in the same circuit. The resulting slight bending of the bimetal element in the dash receiver causes the indicating needle to register zero, or "Empty," as shown in the upper diagram.

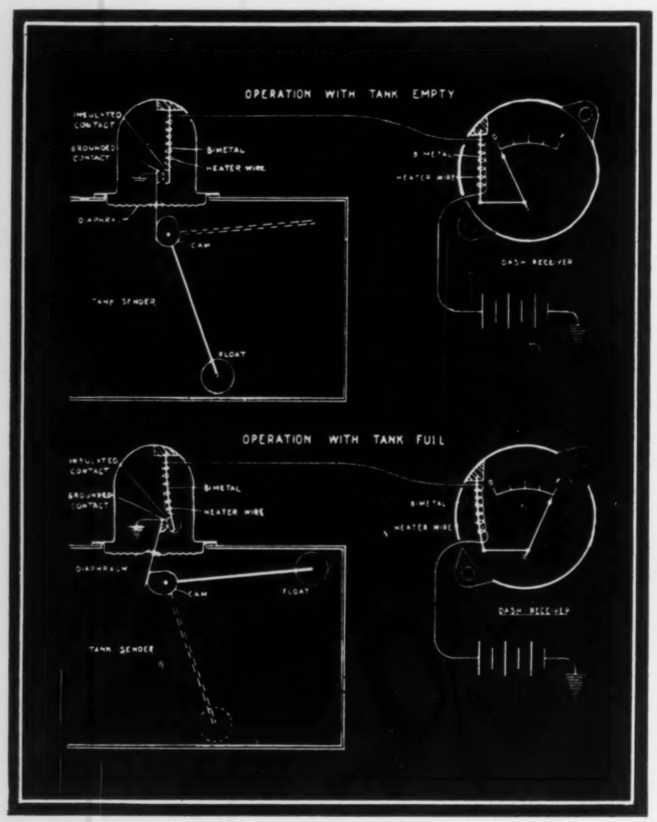

OPERATION WITH TANK EMPTY
INSULATED CONTACT
GROUNDED CONTACT
BIMETAL
HEATER WIRE
DIAPHRAGM
CAM
TANK SENDER
FLOAT
BIMETAL
HEATER WIRE
DASH RECEIVER
OPERATION WITH TANK FULL
INSULATED CONTACT
GROUNDED CONTACT
BIMETAL
HEATER WIRE
DIAPHRAGM
CAM
FLOAT
TANK SENDER
BIMETAL
HEATER WIRE
DASH RECEIVER

Fig. 1—Sympathetic action of electrically connected bimetal elements indicates fuel level to driver

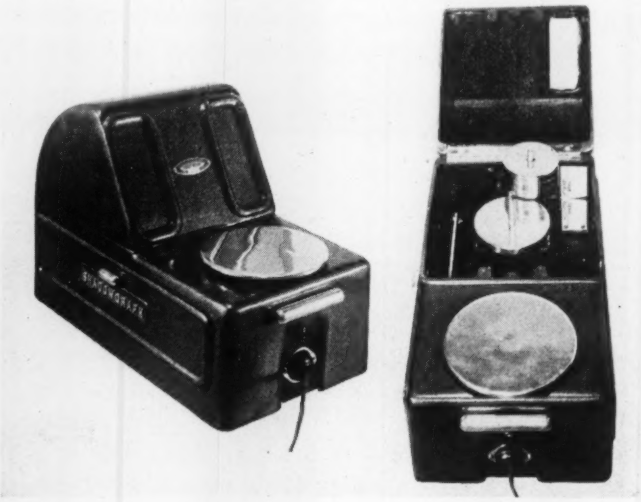

SHADOGRAPH

Fig. 2—Projected shadow of a needle-like pointer magnifies its movement and indicates the exact weight

When the tank is filled, however, the action of the float and cam as shown in the lower diagram, pushes the grounded contact in the sender against the insulated bimetal contact, thereby bending this element. When the ignition switch is on the action described in the foregoing paragraph occurs, but because the bimetal element already is under strain a much greater amount of current is needed to bend it sufficiently to break its contact when in the stressed position. A comparable greater bending likewise occurs in the element in the dash receiver—this action pulling the indicator needle over to the "Full" point. Movement of the needle caused by the make-and-break of the circuit is so minute that it cannot be detected at any position. Furthermore, because bimetal does heat and cool slowly, sudden changes in fuel level caused by driving over rough roads are damped out, a steady reading of the average level in the tank being given.

Shadow Indicates Weight

DESIGNED for precision weighing and for checking predetermined weights, the portable even-balance scale depicted in *Fig* 2 embodies an unusual indicating system. It is read by observing an indicator shadow on a dial visible through a window in the right-hand side of a sloping cover.

This instrument is called the Shadowgraph, and has been designed primarily for industrial use where selective operations involve quick, accurate weighing. Maximum capacity is 5 pounds. There are four 1-pound stack pin weights and a beam with 1 pound range by ¼-ounce increments. Weights, beam, dial, etc., are visible in the uncovered view in the cut.

A needle-like pointer mounted on an outrider arm intercepts a beam of light thrown by a standard automobile bulb. Although no mirrors or reflectors are used, a shadow of the pointer magnified thirty times appears on the illuminated dial, which may be provided either with over and under graduations or simply with tolerance limit markings. While no part of the mechanism moves more than 3/16-inch, the multiplying effect of projection is such that the shadow of the pointer moves 2 inches on the dial for each ounce over or under weight. Models can be furnished for either direct or alternating current illumination.

The mechanism, which is a simple system of cast iron levers, has agate bearings and hardened tool steel chrome plated pivots. Balance ball, beam and poise, weight rack, etc., are fully enclosed by a dustproof aluminum housing, the weighing platter being the only exposed moving part. Oscillation is prevented by an oil dash pot, which—together with elimination of parallax through use of the shadow indicator point—assures fast, accurate reading. As this scale does not require leveling it can be used on rough benches.

Power Take-off Winds Cable

DEVELOPED to enable tractors of crawler type to function as "stationary" as well as "locomotive" power plants, the Le Tourneau cable-winding power take-off attachment shown in section in *Fig.* 3 has interesting design features.

This unit, which is of all-steel welded construction, is bolted on the rear of the tractor below and behind the driver's seat. Thus it is enabled to derive its power through a splined shaft direct from the tractor gears. At the same time its single control lever is in a position which enables the driver to watch the road ahead or to control the operation being performed through the take-off mechanism with equal ease.

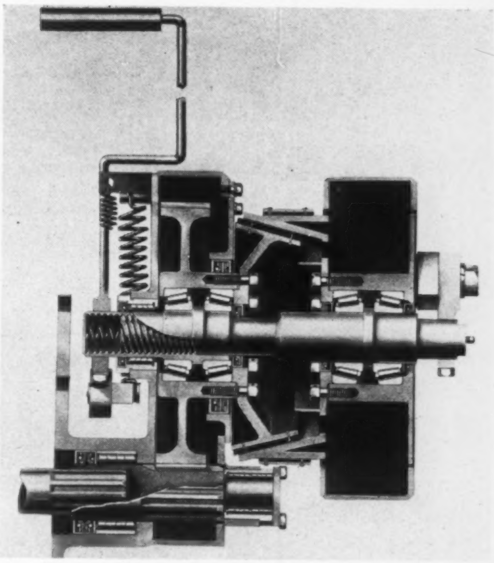


Fig. 3—This power take-off enables a tractor to wind in and pay out a cable

The splined shaft from the tractor gears carries a pinion in the form of a sleeve which meshes with a large gear having bolted on its hub the inner member of a cone clutch of generous size. The outer member of this clutch is fastened to the hub of the cable-winding drum and encircling this outer member is a band brake. Through the center of the winding drum and drive gear runs the clutch operating shaft.

To engage the clutch, the lever which is mounted on an internally threaded sleeve screwed on the inner end of the clutch shaft, is pushed sidewise. This draws the shaft toward the tractor, thereby releasing the brake and seating the clutch members, thus starting the cable drum. When the lever is in neutral position, the band brake is kept tight by a heavy tension spring, locking the cable drum. When the lever is pushed over in the other direction the drum becomes free running. The brake is released against spring tension by an arm on the hand lever, which cams down an arm on a side shaft on the other end of which a short lever and link complete the connection to the free end of the band.

Study of *Fig.* 3, which has been made from a wash drawing of the mechanism, shows what liberal use is made of roller bearings and rotary seals in mechanisms such as this one. The operation of the device utilizes both the radial and the thrust load-taking ability of the two sets of opposed tapered roller bearings on the clutch shaft and its sleeve. When the clutch is engaged these two sets of bearings are pulled toward each other.

The attachment is used for hoisting, dragging scrapers, etc., and is built in single, double and four-drum units.

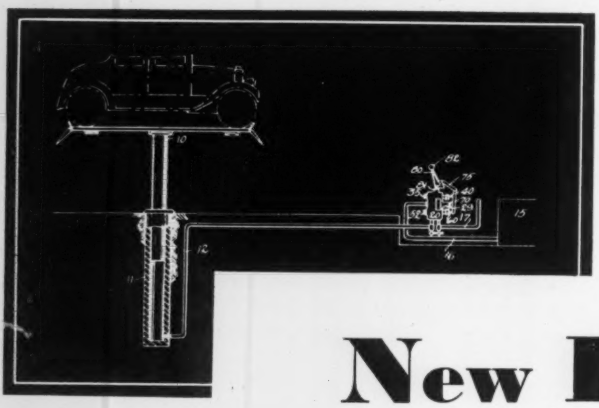


Fig. 1—Careful recording of each step in the development of a device such as this may avoid lengthy patent controversy

New Patent Regulations

SINCE publication of the patent articles in the March and November, 1933, issues of MACHINE DESIGN, the Patent Office has, in certain definite particulars, modified its rules relating to interferences. As a consequence, even more stress should be placed upon the importance of keeping proper engineering records of inventions to guard against the loss of priority when two or more inventors claim the same invention.

The amended rules lay more emphasis on "provable acts" than did the old ones. Thus, under the old rules, it was desirable for each contesting inventor in an interference proceeding through the Patent Office to allege a "date of conception" for his invention as far back as possible, even though a doubt might have existed as to whether or not this date could be proved. Such practice rarely brought any eventual advantage to the party claiming early conception, but it wreaked extraordinary hardship on the first inventor by delaying the issuance of the patent to him, sometimes for many years. Under the new rules any allegation which tends to stretch the "date of conception" as early as possible, beyond "provable dates," will not result in any advantage to the claimant making the allegation. The significance of the amended rules and the manner in which they reflect the necessity of keeping recorded evidence may best be illustrated by taking a typical interference proceeding through its various stages.

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Let us suppose that Mr. Smith invents the hydraulic lift shown in *Fig.* 1, and files a patent application. Mr. Jones is another inventor, and we will assume that he invents the hydraulic lift shown in *Fig.* 2 at about the same time that Smith made his invention, a frequent coincidence. When Jones files his patent application, this means that there are two pending applications claiming substantially the same invention. These facts are illustrated in *Fig. 3A,* where *F* indicates the respective filing dates of Smith and Jones and the length of the horizontal lines represents time.

When Smith files his application it is accompanied by an oath which states, in part, "—That he verily believes himself to be the original, *first* and sole inventor of the improvement in hydraulic lifts described and claimed in his annexed specification—." Jones takes a similar oath. This means that so far the Patent Office does not know from the mere reading of the respective oaths who is the true and *first* inventor.

There are some inventors and manufacturers who entertain the idea that the first to file his patent application is the first inventor. This is not necessarily true. The date of filing is merely *presumed* to be the date of the invention. Each party may carry back the date of his invention by clear and convincing evidence to an

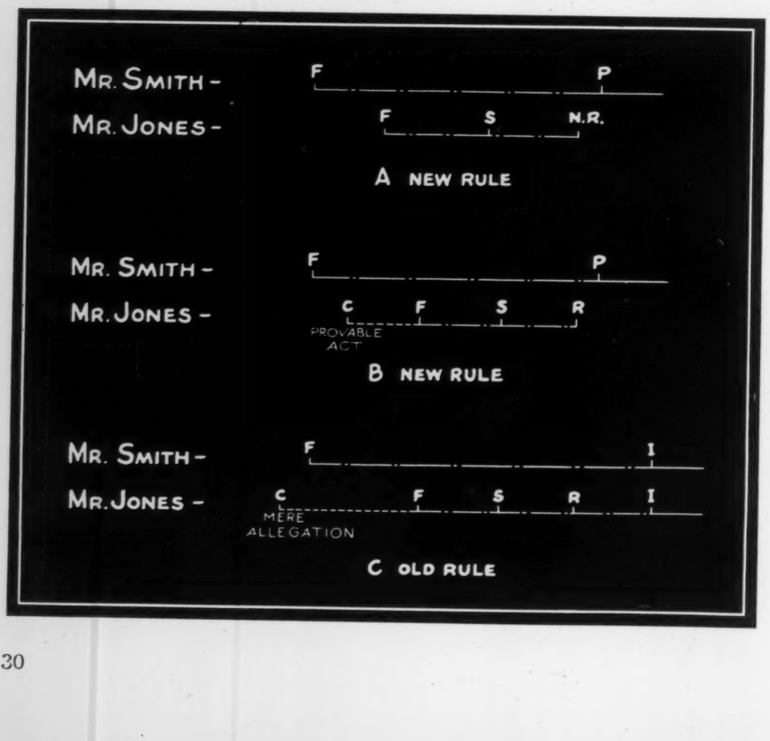


Fig. 3—Left—As indicated at B, refineme in the patent rules will aid in eliminat doubt as to the first inventor. Fig. Right—Steps in an involved patent c troversy are shown diagrammatical

By George V. Woodling

ns Stress "Provable" Acts

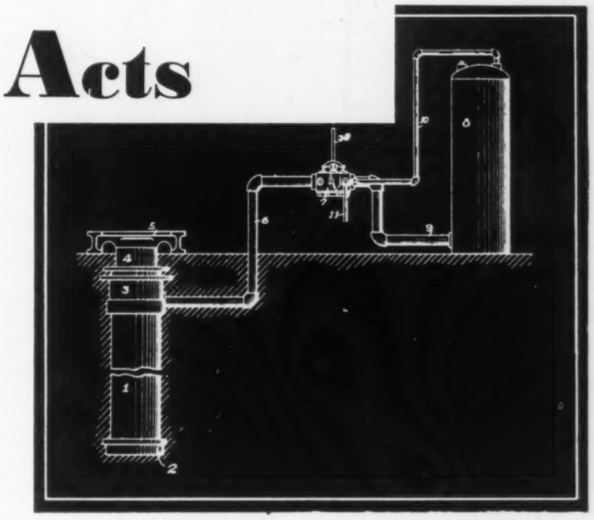


Fig. 2—The similarity between this machine and that shown in Fig. 1 might lead to interference proceedings

earlier date, provided the earlier date, as will be explained later, is not so far back as to make the party guilty of unreasonable delay in filing his application. Thus, the mere fact that Smith might have filed his application before Jones does not necessarily mean that Smith will be declared the first inventor and awarded priority of invention.

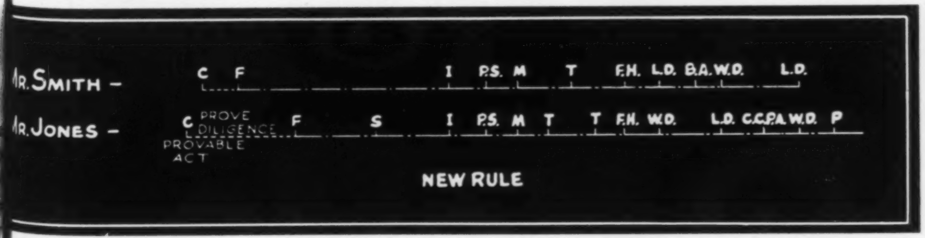
Must Determine the Prior Inventor

Before the Patent Office will grant a patent to either inventor it will declare an interference to determine who is the prior inventor and entitled to the patent. However, before the interference is actually set up the Commissioner of Patents may call upon the Junior applicant (Jones, second to file his patent application in the Patent Office) and request him to state in writing under oath the date and the character of the earliest fact or act, susceptible of proof, which will be relied upon to establish conception of his invention. This statement is indicated in *Fig. 3A* by the symbol *S,* and should Jones fail to make a reply as indicated by the Symbol *N.R.,* within the time specified, not less than 20 days, the Commissioner will proceed upon the assumption that Jones' "date of conception" is the date of the execution of the oath attached to his application. In this case the patent would, in due course, be granted to Smith, as indicated by the symbol *P.*

In order that we may carry the interference proceeding to the next step, let us assume that Jones replies to the Commissioner and states, under oath, the date and the character of the earliest provable fact which will be relied upon to establish conception of his invention. But when the Patent Office examines Jones' reply, it finds that his "provable acts" occurred subsequent to the filing date of Smith. These circumstances are illustrated in *Fig. 3B,* where *C* indicates the provable "date of conception" and *R* the reply. Under these circumstances the Commissioner will reject Jones' application and grant the patent to Smith, unless Jones can show cause why his application should not be rejected.

The truth of the matter might have been that Jones actually did invent the hydraulic lift before Smith's filing date, but since he made no recorded evidence of it he is restricted to a later "provable" date. Here is a case where an honest inventor lost out because he failed to take the precaution to record the earliest acts of his conception. It is well to keep in mind that when any Junior inventor makes his reply to the Commissioner of Patents he has no knowledge of who the opposing inventor may be, nor does he know the filing date of the opposing inventor. Thus he is totally in the dark, and, naturally, in order to protect his rights he wants to carry his "date of conception" as far back as possible. To do this under the present rules it is important that the inventor make a "record of invention" just as soon as he thinks of his invention in order that he may not be restricted to a later "provable" date.

Under the old rule, with the same set of circumstances, the junior party did not have to state, under oath, provable acts of conception, but merely was called upon "to set forth as precisely as



possible when he conceived the invention." Thus, it was not necessary for the junior party to restrict himself to the earliest date of which he had recorded evidence. This sometimes led to unfair practices as it encouraged inventors to stretch their "date of conception" beyond the realm of actual proof. Accordingly, the diagram in *Fig. 3C* illustrates what could be done under the old rule, as compared to *Fig. 3B* showing the practice under the present rules. In *Fig. 3C,* inasmuch as Jones alleges a date of conception prior to Smith's filing date, the Patent Office would set up the interference, as indicated by the symbols *I,* so that each party could later take testimony to prove priority. This means that Jones is allowed to take testimony when there is no chance of his winning the interference, with the result that Smith is harmed since the allowance of his application is held up in the meantime, which in actual practice may be as much as 3 to 5 years or more.

The amended rules are designed to correct this situation, and are based upon the proposition that it is clearly of no avail to allow a party to take testimony when he cannot allege a "provable" act of conception prior to the filing date of the opposing party. Therefore, it is readily seen from the foregoing that, if an inventor wants to guard against the loss of priority of invention, it is highly desirable that he keep proper recorded evidence of his earliest act of conception.

Written Records Are "Provable Acts"

With reference again to the present practice, let us now assume that Jones kept a written record of his earliest act of conception, and that in his reply to the Commissioner of Patents he set forth "provable acts" of conception prior to Smith's filing date. This condition is illustrated in *Fig.* 4 and the Patent Office rightfully declares an interference as indicated by the symbol *I.* The first step which the patent office takes in declaring an interference is to notify the opposing inventors.

Ordinarily, in actual practice, the wording of the claims which have common subject matter in each of the opposing applications is not alike, word for word. In such cases, in order to make the wording alike, the Patent Office may do either one of two things: It may rewrite a common claim and send it to the opposing parties and suggest that each copy and insert it in their respective applications; or the Patent Office may select a claim from the application of one of the parties and send it to the other party and suggest that he copy and insert it in his application. In this manner the common claims have the same wording. If a party fails to copy the suggested claim and insert it in his application it will be considered a disclaimer of such part of his invention.

In an interference proceeding each contesting party is required to file a "Preliminary" statement within a time specified by the Commissioner of Patents. The filing is indicated in *Fig.* 4 by the symbol *P. S.*

When the invention is made in the United States the preliminary statement should so allege and show the following facts:

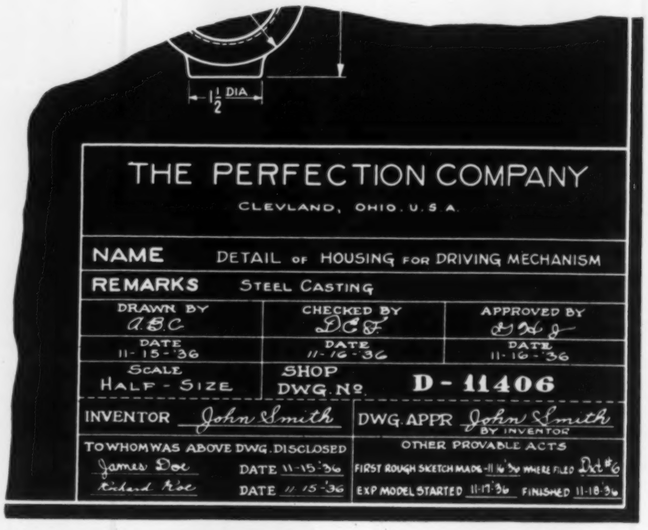
(a) The dates upon which the first drawing and the first written description of the invention were made.

(b) The date upon which the invention was first disclosed to others.

(c) The date of the first act or acts [other than the acts specified in (a) and (b)] which, if proved, would establish conception of the invention, and a brief description of such act or acts.

(d) The date of the reduction to practice of the invention.

(e) The date when the inventor began actively exercising reasonable diligence in adapting and perfecting the invention.



THE PERFECTION COMPANY
CLEVLAND, OHIO. U.S.A.

NAME	DETAIL OF HOUSING FOR DRIVING MECHANISM	
REMARKS	STEEL CASTING	
DRAWN BY A.B.C	CHECKED BY D.E.F.	APPROVED BY G.H.J.
DATE 11-15-'36	DATE 11-16-'36	DATE 11-16-'36
SCALE HALF-SIZE	SHOP DWG. NO. D-11406	

INVENTOR John Smith
DWG. APPR John Smith BY INVENTOR

TO WHOM WAS ABOVE DWG. DISCLOSED
James Doe DATE 11-15-'36
Richard Roe DATE 11-15-'36

OTHER PROVABLE ACTS
FIRST ROUGH SKETCH MADE 11-16-'36 WHERE FILED Dkt #6
EXP MODEL STARTED 11-17-'36 FINISHED 11-18-'36

Fig. 5—Additional information on development drawings definitely establishes "provable acts"

(f) The applicant shall state the date and number of any application for the same invention filed, within twelve months before the filing date in the United States, in any foreign country adhering to the International Convention for the protection of industrial property or having similar treaty relations with the United States.

If a drawing has not been made, or if a written description of the invention has not been made, or if the invention has not been reduced to practice or disclosed to others, or if there have been no other acts which, if proved, would establish conception of the invention, the statement must specifically disclose these facts.

The first sketches and written description referred to in (*a*) comprise the first crude sketches and notes of the invention. Even if these sketches and notes were not signed or dated, still the earliest sketch or written description is the one for which a date can be established.

The first disclosure referred to in (*b*) is not limited to employes of the inventor's company or his immediate associates, but includes anyone to whom he may have described the invention embodied in the claim. The explanation may have been very brief and incomplete or it may have been only vaguely understood, but if it was understood well enough by the person to whom it was told for him to remember it, then the date of that conversation is the date requested.

An example of the first acts or act, as called for under (*c*) would be a case where the inventor encloses a drawing and written description in a self-addressed envelope and mails it to obtain the date of the post mark.

The date of the reduction to practice as called for under (*d*) is the date that the inventor completed the first embodiment of his invention in such form as to render it capable of practical and successful use. This is called *actual* reduction to practice, regardless of how crude it was or might have been, so long as it embodied the essential elements of the invention. It does not, therefore, refer to the date on which the finishing touches and refinements might have been added. The filing of the application in the Patent Office is called *constructive* reduction to practice, and, if the inventor has not made an earlier actual reduction to practice, he should allege the date of the filing of his application as the date of the reduction to practice in the preliminary statement. Models will not ordinarily suffice as an actual reduction to practice.

The date when the inventor began actively exercising reasonable diligence in adapting and perfecting the invention, as called for under (*e*), may sometimes be open to honest debate because here a question arises as to what is meant by "actively" and "reasonable". So many factors enter into this question, which depends upon the surrounding circumstances of each case, that it is impossible to give any all-embracing aid to the inventor in determining the exact date called for.

Modified Drawing Title Advantageous

Consequently, what may be reasonable to one inventor may not, because of changed conditions, be reasonable to another. The best way to be prepared to answer this question is to preserve all models even including discarded parts when making the model, together with a memorandum of the time spent working on the models, letters concerning the invention, shop and engineering reports, minutes of engineering meetings, laboratory record books, trip reports, and purchase orders for materials in making the models or in constructing the full size invention. Another good plan would be to modify the title box of blueprints by adding to the lower part the data indicated below the horizontal dash line in *Fig.* 5; information concerning disclosure to others, other "provable acts", and the inventor's signature and his approval.

Under (*f*), the purpose of calling upon the inventor to state whether or not the invention was filed within 12 months before the filing in the United States in any foreign country adhering to the International convention, is to give the inventor the benefit of the earlier filing date of the foreign country.

After the Preliminary Statement is filed by each inventor and approved by the Examiner of Interference, the next step is for the Examiner to notify each party as to the schedule to be followed in filing motions and in taking testimony. The notice may include a schedule as follows:

The motion period expires July 15, 1935.
Wayne Jones filed Feb. 24, 1931 Ser. No. 621030.
Testimony in chief to close July 19, 1936.
John Smith filed Nov. 22, 1931, Ser. No. 780666.
Testimony to close Sept. 19, 1936.
Rebuttal testimony of Jones to close Oct. 6, 1936.
Final hearing Dec. 20, 1936 at 11 A. M.

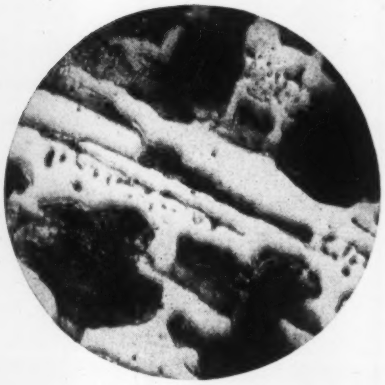
During the motion period, which is designated as being terminated in *Fig.* 4 by the symbol *M*, each inventor for the first time is entitled to inspect the opposing party's patent application but not the preliminary statement, and is entitled to file motions contesting the right of the opposite party to the claim in the interference, upon certain legal grounds which may appear in the opposing application. If the motion is granted, no testimony is taken, because a favorable decision is entered for the party winning the motion. In *Fig.* 4, let it be assumed that the motion was overruled, and that testimony is taken. This is done before a notary and recorded by a stenographer, usually in the office of the inventor's attorney.

Burden of Proof Lies with Last To File

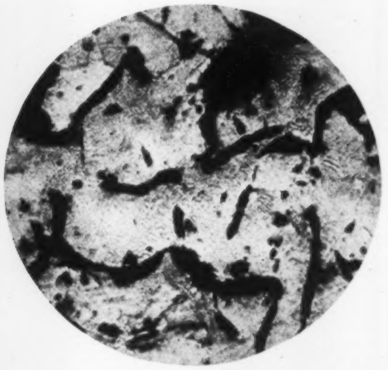
The junior party must carry the burden of proof that he conceived and made the invention before the senior party. This constitutes a hardship, and the odds in the beginning are against the junior party. To overcome this burden the junior party, corroborated by his witnesses, must take testimony first and produce drawings, sketches and written descriptions showing the earliest date of conception and other facts surrounding the making of the invention. Subsequently the senior party, corroborated by his witnesses, is entitled to take testimony, which may be followed later by rebuttal testimony on behalf of the junior party. The taking of the testimony is indicated by the symbol *T* in *Fig.* 4. Upon completion, the testimony and exhibits are sent to the Examiner of Interferences and a final hearing is had by the inventors' attorneys before the examiner, as indicated by the symbols *F.H.* After this the examiner analyses and studies the evidence produced by both parties, makes his decision and awards priority to whom he thinks is the first inventor.

Jones wins the decision, *Fig.* 4, as indicated by the symbols *W.D.*, and Smith loses, as indicated by the symbols *L.D.* Following this decision, we will assume that Smith appeals to the Board of Appeals in the Patent Office, the next higher tribunal, *B.A.*, and Smith wins the decision here, as indicated by the symbol *W.D.*, and Jones loses as indicated by *L.D.* From here we will further assume that Jones now appeals to the court of customs and patent appeals, *C.C.P.A.*, the next higher tribunal, where he wins the final decision, *W.D.*, and Smith loses the decision, *L.D.* Accordingly, as indicated in *Fig.* 4, the Patent, *P*, is awarded to Jones.

Fig. 1—Right—Structure of durable cast iron liner for ore mill. Fig. 2—Below—Unsatisfactory replacement casting. Both magnified 200 diameters



Corrosion Is Discussed at ASME Meeting



AN OUTSTANDING feature of the recent annual meeting of the American Society of Mechanical Engineers was the symposium on corrosion-resistant metals and their use in machinery and equipment. Sponsored by the Iron and Steel division, eight authorities on the more important industrial metals and alloys delivered papers of unusual interest and value. In this report it is impossible to do more than touch high spots in these papers which in printed form occupy 64 pages. However, it will serve to bring this symposium to the attention of engineers and designers.

Picturing the general metals situation in the introductory paper, F. N. Speller of the National Tube Co., Pittsburgh, said: "It does not seem likely that we will find one metal or one general remedy for all kinds of corrosion. The metal and the environment must be mated so as to live together peaceably, at least until the owner gets a reasonable return on his investment.

"It should be remembered that metals are, in a way, quite like human beings; although they are susceptible to unfavorable environment, their resistance can be built up by inoculating them with alloying elements and by keeping their surfaces reasonably clean and free from foreign deposits."

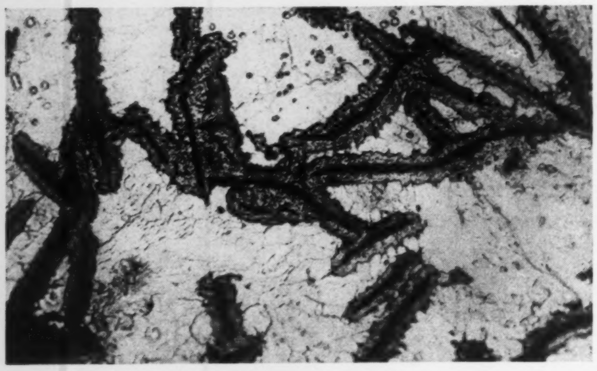


Fig. 3—Effect of caustic attack on coarse grained cast iron, magnification 200 diameters

E. H. Dix Jr. and R. B. Mears of the Aluminum Research Laboratories, New Kensington, Pa., sounded a note of warning against dependence on "cook book" data in choosing aluminum alloys for specific applications. They emphasized that detailed knowledge of conditions of service is necessary before a definite recommendation can be attempted. Even then it is preferable to conduct pilot tests before going into large installations.

Following is their summary of the effect of various substances on aluminum and its alloys:

(1) *Atmospheric Exposure:* Pure aluminum or the resistant aluminum alloys are little affected by even rather long periods of exposure to the atmosphere in a wide range of different locations. If it is desirable that bright surface be maintained, the alloy should generally be aluminated.

(2) *Marine Exposures:* The Alclad aluminum alloys

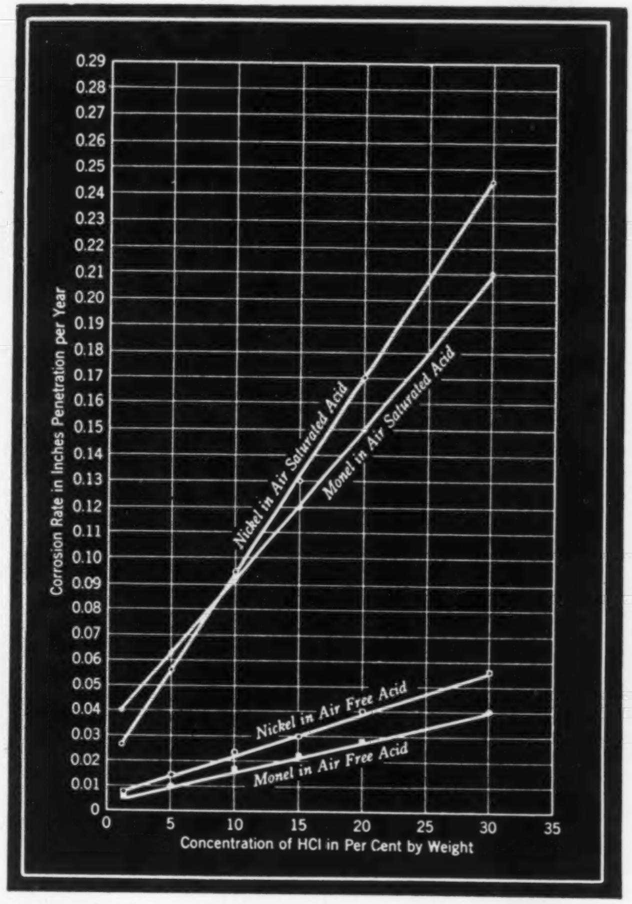


Fig. 4—Resistance of nickel and Monel to corrosion by hydrochloric acid at atmospheric temperature

and 52S and 53S are highly resistant to sea water and salt spray.

(3) *Neutral Salt Solutions:* Aluminum and many of its alloys are little affected by solutions of most neutral salts. The halogen salts are more active so that special precautions must sometimes be taken if aluminum is to be used in direct contact with their solutions.

(4) *Alkaline Salt Solutions:* Aluminum is generally attacked by alkaline salt solutions. This attack can be inhibited by the addition of sodium silicate.

(5) *Acid Salt Solutions:* Solutions of salts of the heavy metals having an acid reaction are generally quite corrosive to aluminum. This is especially true for the halogen salts. Oxidizing acid salts, such as potassium dichromate, generally do not attack aluminum.

(6) *Mineral Acids:* Either very dilute or very concentrated nitric or sulphuric acids have little effect on aluminum. Intermediate concentrations are quite corrosive. Sulphurous acid attacks aluminum only slowly at concentrations up to 1 normal. Boric acid has very little action on aluminum, even up to saturated solutions. However, the halogen acids are quite corrosive.

(7) *Organic Acids:* Most organic acids do not have much effect on aluminum unless they are almost devoid of water. However, formic, oxalic and mono-and tri-chlor acetic acids are rather corrosive.

(8) *Alkalis:* Sodium and potassium hydroxide solutions readily attack aluminum at all but the lowest concentrations. Ammonium hydroxide does not seriously attack aluminum.

(9) *Organic Solvents:* Aluminum is not appreciably attacked by a wide range of organic liquids. However, some—for instance, alcohols—do attack aluminum if completely anhydrous.

(10) *Gases:* Dry gases are generally inert to aluminum. Many moist gases such as ammonia and hydrogen sulphide also have little effect on aluminum while some other moist gases have slight action. Moist chlorine is decidedly corrosive.

Regarding zinc, E. A. Anderson of the New Jersey Zinc Co., Palmerton, Pa., remarked that while chemists are inclined to think of it as a chemically active material, engineers think of it primarily as a valuable protective coating—especially for steel—and as an important constituent in die castings. He dealt particularly with zinc as a coating.

H. L. Maxwell of E. I. du Pont de Nemours & Co., Wilmington, Del., in his paper attributed wide use of cast iron in machinery and chemical equipment, primarily to two factors; first, its ready availability (cast iron foundries are found almost anywhere); and second, its low cost (3½ to 6 cents per pound).

Of a number of examples of improvement in machinery through intelligent selection of alloys of cast iron for vital parts the cases covered by *Figs.* 1 and 2 are particularly interesting to designers. In an ore grinding mill the original chilled alloy iron lining plates gave about 500 days service. Replacement liners supplied by the same manufacturer and containing the same alloy ingredients gave only 75 days service. Analysis showed that the difference came about through variation in the percentage of the ingredients, that of silicon being higher in the replacement liners and chromium and nickel lower.

Fig. 1 is a microphotograph showing the grain struc-

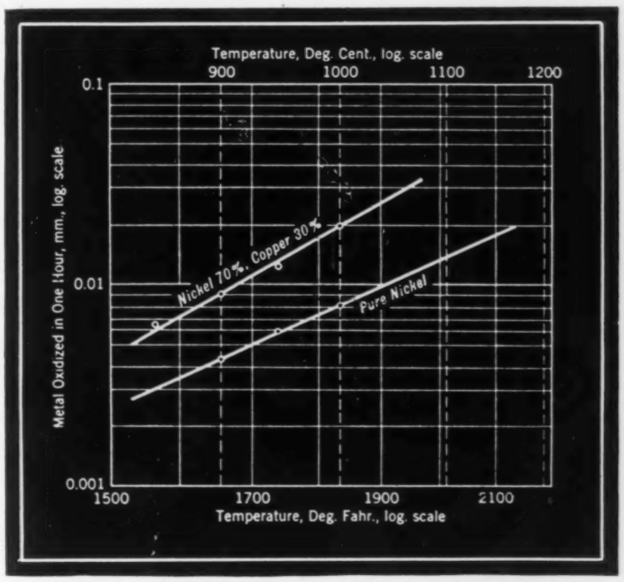


Fig. 5—Rate of oxidation of nickel and of Monel metal containing 70 per cent nickel, in air

ture of the metal in the original liners, while *Fig.* 2 shows that in the replacement; magnification being 200 diameters. Note in *Fig.* 1 the large areas of wear-resisting free carbide responsible for prolonged life; and relative absence of free carbide among the soft graphite flakes in *Fig.* 2.

In ordinary coarse-grained cast iron large areas of graphite permit infiltration of corrosive constituents into the body of the casting, contributing to early failure. This is illustrated in *Fig.* 3, which shows the effect of caustic attack on ordinary coarse grained cast iron, magnified 200 diameters. Note that the caustic has advanced into the body of the metal, making its way along the coarse graphite tendrils.

Although Mr. Wilkins' paper is of considerable length and points out the salient characteristics of copper and its principal alloys, he admitted that the subject is so broad that he could not dwell in detail on any specific alloy. He therefore included a bibliography with 117 references.

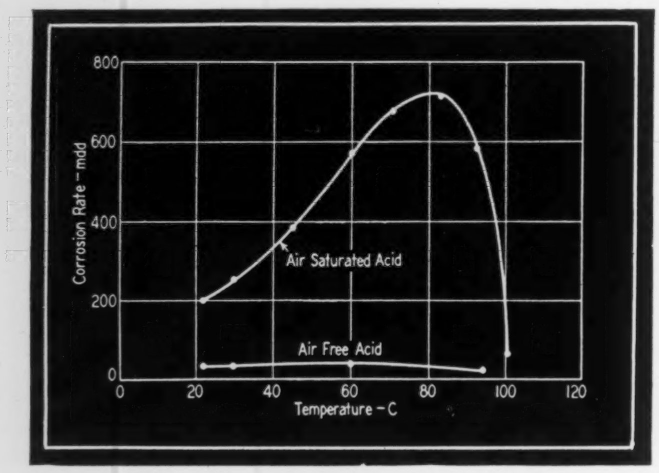


Fig. 6—Effect of temperature on corrosion of Monel metal in 5 per cent sulphuric acid

Mr. Wilkins said that designing engineers often overlook the fact that cuprous materials do not have a "yield point" in the sense in which that phrase is used in connection with ferrous materials. Therefore, when "yield points" or "yield strengths" are given for cuprous materials, they are merely expressions of a property that by custom is assumed to exist but which in fact has no existence. Inasmuch as such figures are only approximations of the value of elastic limits, he recommended that designs be based on elastic limits when employing copper and its alloys.

According to J. H. Critchett of Union Carbide and Carbon Research Laboratories, New York, it is significant that all the stainless steels depend on the presence of chromium for their major corrosion-resistant properties.

The 18 per cent chromium—8 per cent nickel steels are by far the most popular of the stainless variety. They are easily rolled, fabricate without difficulty and when carbon is adequately combined with columbium or titanium, present no difficulties in welding. Ductility is high allowing deep-drawing and other cold working. They are useful not only where corrosion-resistance is important but also where strength and permanence are major requirements.

Monel Is Comparable to Steel

The paper by F. L. La Que of International Nickel Co., New York, is a thorough treatise on nickel and its alloys, including Monel metal. He emphasized that the Monels possess mechanical properties comparable to high-strength alloy steels. Furthermore, these high-nickel alloys retain their strength, ductility and toughness over a wide range of temperature conditions. Hydrochloric (muriatic) acid is difficult to handle with most metals and alloys, nickel being one of the few possessing useful resistance to it. Limiting rates of corrosion in the cold acid are shown in *Fig.* 4.

Mr. La Que mentioned that even where rate of tarnishing is greatest there is no destructive corrosion of Monel. Its ability to remain free from such effects as rusting in indoor atmospheres—combined with its resistance to corrosion by food products and cleaning solutions—accounts for its widespread use in food processing and handling equipment. Data on rates of oxidation of nickel and Monel are given in *Fig.* 5.

Following is Mr. La Que's table giving resistances of nickel to corrosion by juices encountered in processing, bottling and canning machinery: (Note "i p y" means "inches penetration per year.")

Material	Condition	Corrosion rates, ipy
Tomato juice	Aerated, room temperature	0.012
Tomato juice	Unaerated, room temperature	0.008
Tomato juice	Fully aerated 165 F	0.024
Tomato juice	Fully aerated 190 F	0.020
Lemon juice	Aerated, room temperature	0.020
Lemon juice	Unaerated, room temperature	0.0005
Lemon syrup	Fully aerated, room temperature	0.001
Diluted lemon syrup	Fully aerated, room temperature	0.034
Lemon juice	Boiling under reflux	0.014
Pineapple juice	Aerated, room temperature	0.018
Pineapple juice	Unaerated, room temperature	0.0035
Pineapple juice	Alternate immersion 132 to 178 F	0.010
Pineapple juice	Fully aerated 180 F	0.036
Pineapple juice	165–175 F, 16–18 in. vac.	0.0045
Grape juice	Aerated, room temperature	0.025
Grape juice	Unaerated, room temperature	0.006
Grape juice	Boiling under reflux	0.007
Orange syrup	Fully aerated, room temperature	0.0007
Diluted orange syrup	Fully aerated, room temperature	0.025
Orange juice	Boiling under reflux	0.008
Pea brine	Boiling	0.0012
Corn brine	Boiling	0.001

Experience has shown that for handling sulphuric acid below 80 per cent concentration, Monel is the most generally serviceable of the commercially available strong malleable materials. Effect of temperature on behavior of Monel in 5 per cent sulphuric acid is shown in *Fig.* 6, the symbol "mdd" meaning weight loss expressed in "milligrams per square decimeter per day (24 hours)."

Oil Pad Bearings Prove Effective for Massive Equipment

By J. Ormondroyd

SCIENTIFIC progress depends upon the instruments available, and, in astronomical observations, those instruments require the ingenuity of the machine designer—today's telescopes being precision machines. The interesting 200-inch telescope to be installed at California Institute of Technology demonstrates the ability of the designer to meet exceptional requirements. This million-pound machine had to have the ability to operate as precisely as a watch; it had to be absolutely rigid so that exact readings and photographs could be obtained; and in addition it had to be designed to carry observers without effecting its accuracy.

One of the most unusual design points in this machine, built at the turbine plant of Westinghouse Electric & Mfg. Co., is the mounting for the polar axis bearings. The telescope, a diagrammatic layout of which is shown in *Fig.* 1, must rotate about its polar axis without the slightest vibration, either radially or torsional-

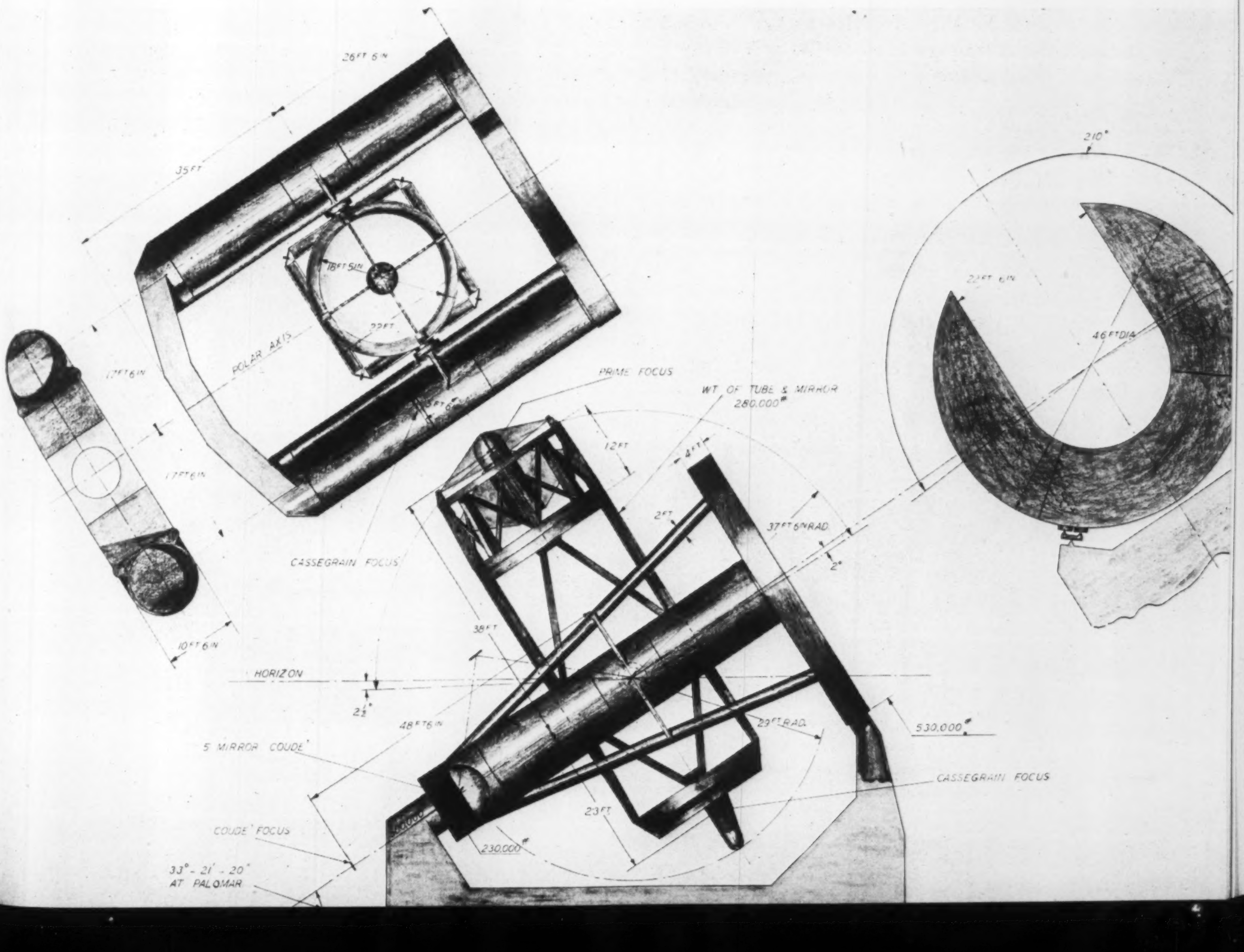

26FT 6IN
35FT
18FT 5IN
22FT
POLAR AXIS
17FT 6IN
17FT 6IN
10FT 6IN
PRIME FOCUS
WT. OF TUBE & MIRROR
280.000#
12FT
4FT
2FT
37FT 6IN RAD.
2°
CASSEGRAIN FOCUS
38FT
HORIZON
2½°
48FT 6IN
29FT RAD.
530.000#
5 MIRROR COUDE'
CASSEGRAIN FOCUS
23FT
COUDE' FOCUS
230.000#
33° - 21' - 20"
AT PALOMAR
210°
22FT 6IN
46FT DIA.

Fig. 1—Supporting structure of million-pound telescope is designed to be absolutely rigid

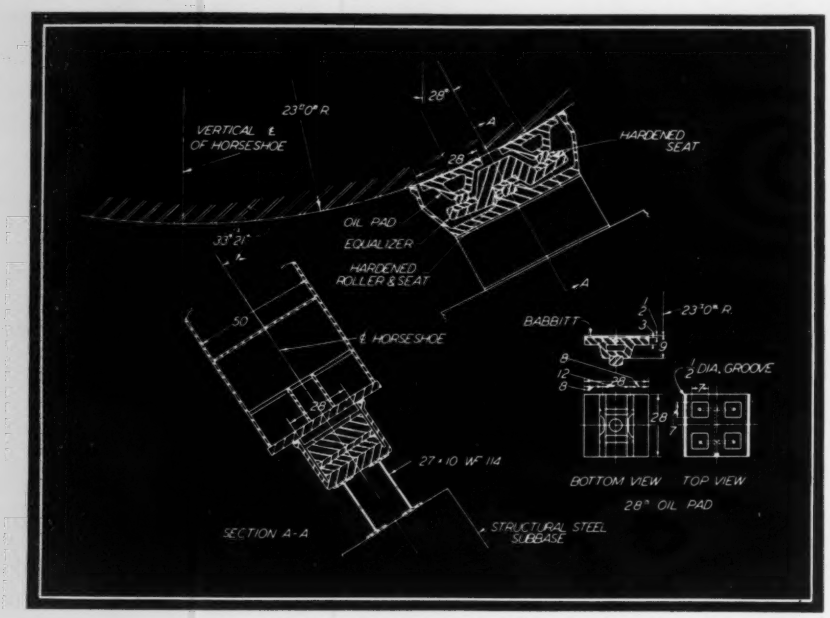


Fig. 2—Oil pad bearings as shown can adjust themselves to local deflections

ly, as this would blur the photograph of the stars or vary the total star light intensity entering the slit of the spectrographs.

The possible use of mercury flotation of the bearings was eliminated by the magnitude of the flotation structures and mercury containers which would be required. Also, any mercury tanks around the south gearing would limit the view of the telescope to the south. In a machine of this immense size and type rollers or ball bearings would give rise to friction with unpredictable variations. Rollers around the horeshoe would have to be supported in a complicated linkage in order to allow for expansion, overall deflection of the yoke and local deflections on the horseshoe outer periphery. At the south polar end usual types of ball and roller bearings could be used, although they would be unusually large.

Bearings Float in Oil

The whole polar axis bearing problem was solved in a simple and comparatively economical manner by using the construction shown in *Fig.* 2 at the north polar bearings, the right end of the yoke shown in *Fig.* 1. This north bearing floats in oil introduced at an average pressure of 250 pounds per square inch to four oil pads arranged two on each side of the vertical center line, *Fig.* 2. Each pad can adjust itself to local deflection by turning on a hardened seat; an equalizer bar rotating about a hardened steel roller equalizes the load between the two contiguous bearings.

Oil is admitted to each pad through four separate orifices symmetrically placed in the carrying surface. The loaded surface is babbited and about each oil inlet orifice the babbit is recessed. High pressure oil flow to each inlet, provided by positive displacement pumps, is governed by a fixed orifice or needle valve rather than by the oil gap to give stability of position for the pad through equal distribution. Air bells in the feed lines will keep the pressure completely steady at the supporting surface.

Fig. 5 shows how the same principle is carried out at the south bearing. Here the bearings consist of zones of two spheres, 75 inches in diameter, the one enclosing the other. These parts are of cast steel, babbited. Oil inlet orifices are so distributed that the bearing is centralized under the existing thrust and radial loadings.

Thus the whole million-pound precision instrument floats on oil. It is estimated that the flow of oil necessary to float the telescope with oil gaps about 0.003 inches thick will be so small that only 1/15 horsepower will be needed to drive the pumps. Larger horsepower will be used, however, to overcome the friction in the feed lines and in the pump itself. More than one pump is available, the pumps being interlocked in such a way that should one fail the drop in pressure in the line will start the other. The telescope polar axis drive will also be interlocked to the pumps in order to stop the drive in case of lubri-

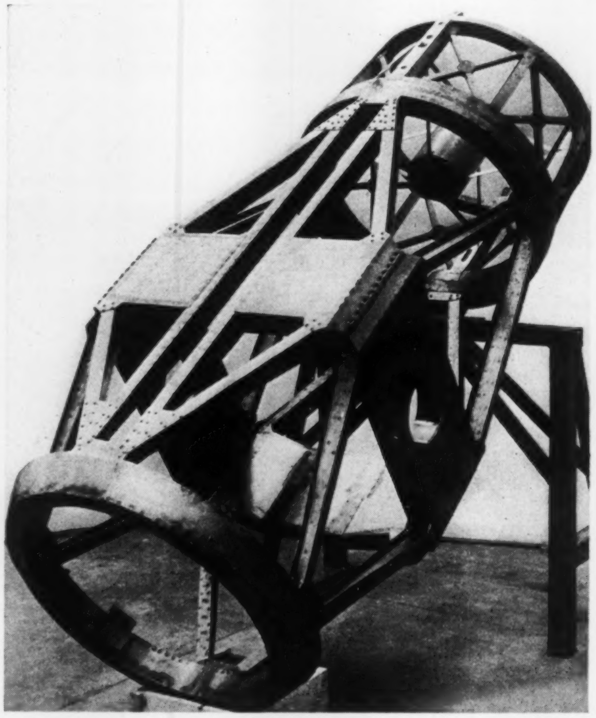


Fig. 3—Tube is made in eight main welded subassemblies which are riveted together

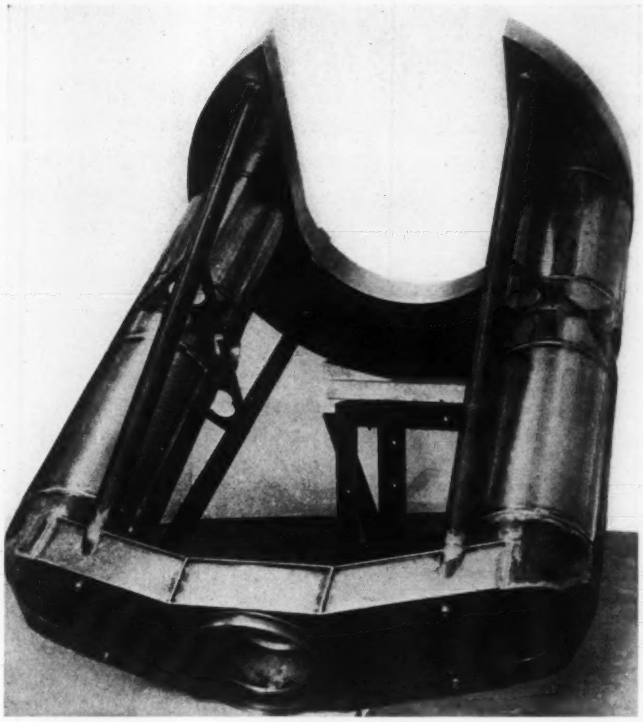


Fig. 4—Extensive use of welding on this yoke assures complete rigidity of the structure

cation failure.

Polar and declination drives and gears are not yet designed, but it is estimated that a ½-horsepower motor will be sufficient to overcome inertia and friction in driving the mounting about the polar axis. At the regular operating speed of one revolution per day the horsepower needed to overcome the polar axis bearing friction will have the unbelievably small value of 1/165,000 horsepower. Even with motor losses and gear friction the polar axis motor will not draw enough current to give an indication on an ammeter.

The declination bearings, which do not rotate as continuously or through such large angles as the polar bearings, are ball bearings housed in the central section of the side girders. Each of the two declination trunnions is supported in three ball bearings. The largest bearing is closest to the telescope tube and is 44-inches outside with 4-inch balls.

Another interesting device, *Fig.* 6, unique in telescope design, is used to connect the tube to the declination trunnions. This inverted bicycle wheel is a flexible gimbal, replacing a spherically seated ball bearing or other type of gimbal having joints at which relative motion takes place. Relative motion would give rise to somewhat unpredictable friction moments leading to possible undesirable deformation of the tube structure. The gimbals used, one on each side, give the tube a two-point support with practically negligible bending moments about the points. Inner and outer flanges are nickel-chromium-molybdenum steel castings. Spokes are chrome-molybdenum steel bars, comparatively stiff in tension and compression but extremely flexible in bending.

Observers Will Ride the Tube

These bearings and supports make possible the design of the unique tube and supporting structure of this 200-inch telescope which has provisions for observers located at the top of the tube near the prime focus, in the side girders and at the Cassegrain focus under the mirror. Observers will ride these points in supports suspended by swivels to keep them in the erect position. This is made possible by the enormous mass and the relatively great stiffness of the structure which gives it stability against disturbances caused by motions of the observers. Movable balance weights will be attached to the structure to keep the center of gravity of the tube on the declination axis.

The design of the tube itself, *Fig.* 3, (a tenth-scale

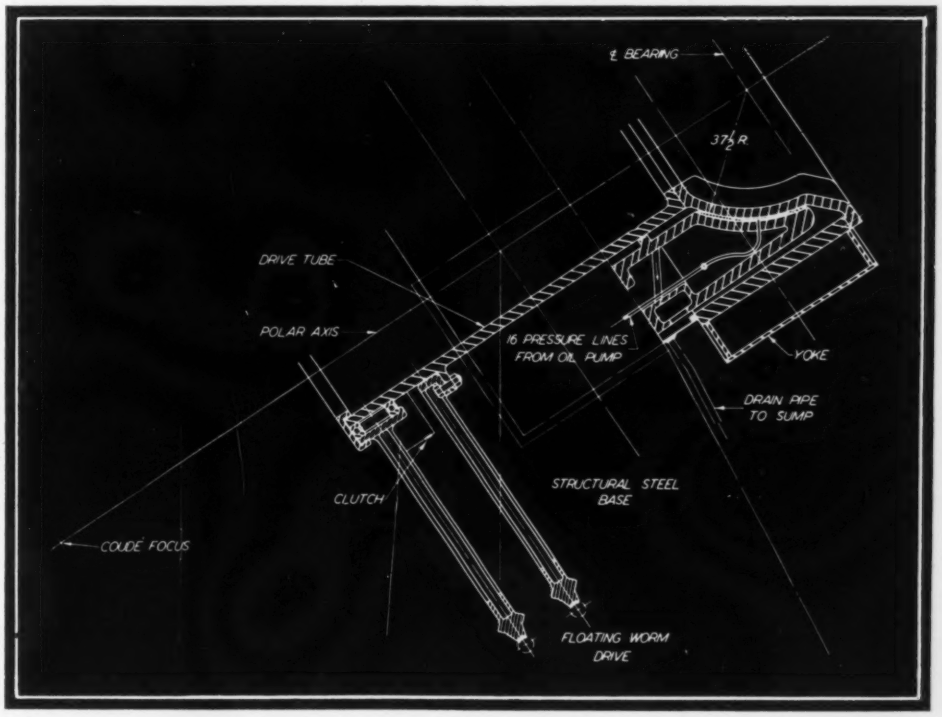


Fig. 5—Oil inlet orifices are distributed so that the bearing is centralized under loadings

model), is beautifully simple and direct, making possible the calculation in advance of its linear and angular deflections in all positions. It is made in eight main subassemblies together with twelve separate I-beams connecting the various parts. Subassemblies are welded box structures, the east and west panels containing bores to receive the gimbals which connect the tube to the declination axis.

At the top of the tube, the north end, is the diaphragm case, a single welded structure 22 feet in diameter and 12 feet high. This piece holds the cylindrical housing which contains the prime focus equipment and the observers' house. This cage can be rotated into four different positions relative to the top ring of the tube. It is held in position by a circular key and dowels.

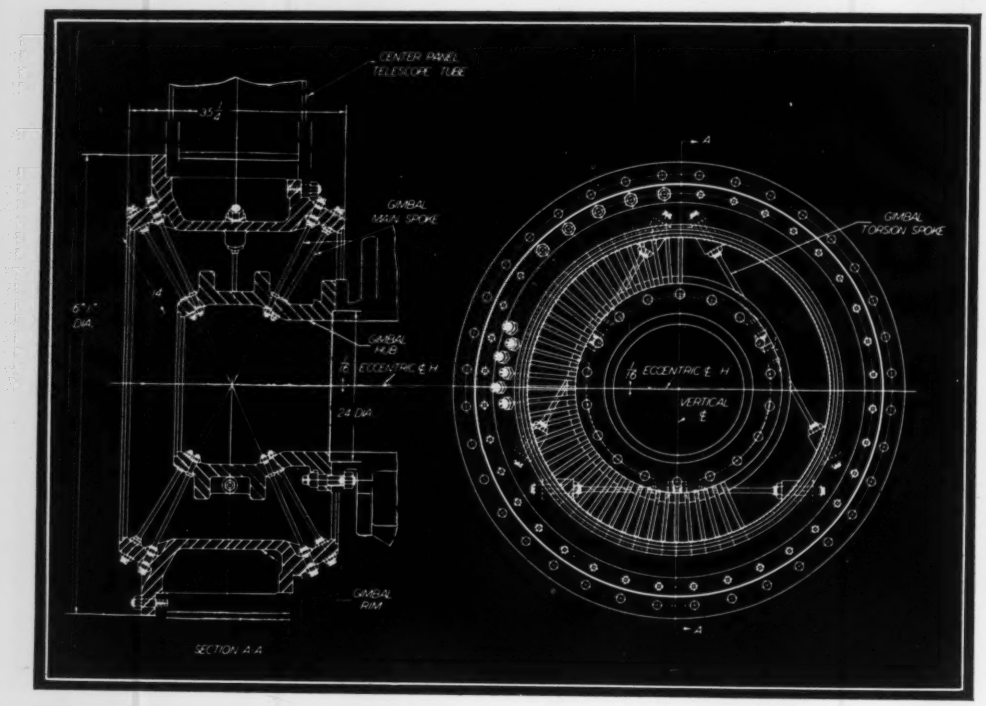


Fig. 6—Flexible type of gimbel eliminates possibility of relative motion between parts

Hollow Box Structures Used

The south ring is a hollow box structure with the outer walls tapered inwardly to meet the dimensions of the mirror cell (not shown) which is hung below it. Along the south side of the tube is a slot through which light beams pass to go into the Coude focus located in a temperature controlled room south of the instrument.

Fig. 4 shows the tenth-scale model of the yoke, supporting structure for the tube. This consists of ten main sections and four bracing tubes. The horseshoe at the north end is made in three sections, the bottom center section and two similar horns. Each section is of hollow box construction, the flat outer walls being steel plate one inch thick and the inner and outer peripheries being made of steel plate 4 and 3½ inches thick respectively. The flanges which connect the sections together are internal, while the horseshoe has internal steel plate bracing members used primarily to stiffen the outer periphery against local deflections at the points where the oil pad bearings are in contact with it.

Side girders are also made in three sections of one-inch steel plate. The cylinder is rolled to shape and tied together with one longitudinal welded seam. At each end there is an internal bolt flange 2½ inches thick. No internal bracing beside the bolting flanges is used in these side girders. The spaces north and south of the declination section are kept clear to house spectrograph chambers to be used with the modified Cassegrain focus.

The south girder is a hollow box structure welded from ⅞-inch steel plate. Internal bracing is used to stiffen this member. Manholes at the ends of the south girder give access to the spectrograph chambers in the side girder. Brace pipes are hollow seamless tubing with ½-inch walls.

Both the tube and the yoke are made entirely of low carbon hot rolled steel, a material selected for its suitability for welding. Before machining the mating surfaces of the subassemblies every fabricated part is stress relieved at 1150 degrees Fahr.

These careful provisions round out a mechanical design which ensures precise astronomical observations.

Do We Need More Inventions?

MORE inventions, not fewer, are needed to gear the wheels of mass production to greater speed and provide additional production that will bring unemployment to a minimum. We need more goods at a lower price, within a range where more of our people can be induced to buy, and afford to pay—not less goods at a higher price. Our unemployment problem cannot possibly be solved by any other method."—M. E. COYLE, president and general manager, Chevrolet Motor Co.

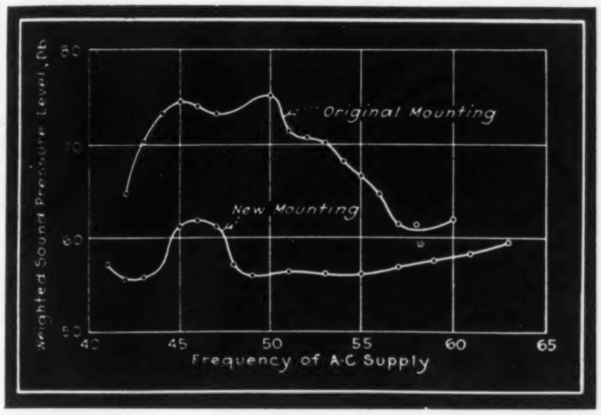


Fig. 1—Removal of part of the resilient material in an isolator reduced the noise of the machine as shown in the lower curve

Quiet Machinery Often Costs Less

By Ernest J. Abbott

EACH noise problem involves different controlling factors, and each requires a different technique of attack. This paper consists of a brief outline of some of these problems. The examples are complete in themselves; the particular problem is stated, the important factors mentioned, the method of attack indicated, and the results outlined.

It often happens that the actual cause of the noise is obscure, and experimentation can be almost endless. The following example indicates how acoustical measurements can be used to advantage in such cases.

A manufacturer encountered difficulty with noise in his machine. As is so often the case, it seemed almost impossible to locate the cause. Many of the machines were satisfactory but others were noisy. Most careful checks of limits and tolerances showed no differences between the noisy and the quiet units. Units made with especially close tolerances were often noisier than average. Assemblies made from the parts of previously rejected machines were often quiet. This just did not make sense.

QUIET machines don't "just happen". They are only the result of careful design followed by systematic checking to locate those parts creating the most disagreeable noises. In this article, abstracted from a paper presented at the recent Mechanical Engineers' meeting, the author shows how typical noisy machines can be analyzed to eliminate the noisy parts, often with a reduction in production costs. Mr. Abbott is a member of Physicists Research Co., Ann Arbor, Mich.

After making various acoustical measurements, the run shown in the upper curve of *Fig.* 1 was made. The machine was operated by an ordinary induction motor, which operated at essentially constant speed. To determine the effects of moderate changes of speed, the frequency of the power source was varied. As shown in the upper curve, a slight reduction in frequency (speed) increased the noise nearly 15 decibels. This increase was easily traced to resonance in a vibration isolator which formed part of the machine. Herein lay the explanation of the trouble. On some of the machines, differences in weight of castings and stiffness were sufficient to bring the operating condition up on the side of this curve; on others, the operation speed would come near the minimum. Different assemblies of the same basic parts might shift the critical frequency for better or worse. Practical quieting often is obtained by removing material, and lessening cost of production rather than adding additional material to a noisy machine and increasing cost. Acting on this theory, part of the resilient material in the isolator was removed, with the results shown in the lower curve of *Fig.* 1. Not only was the peak eliminated so that production variations produced no effect on the noise, but the level was also lowered.

Obvious Source Is Misleading

The next example deals with a case in which the source of the noise was apparently obvious, but in which the solution lay in quite a different direction.

A manufacturer of domestic refrigerators had trouble with motor noise. In fact, the trouble was so serious that he paid a premium for motors especially selected for quietness.

Frequency analyses were made of the noise of the unit to determine which sounds were most prominent and which parts were responsible for them. (Often the noise is not caused by the part from which it is radiated and which apparently is the source.) As anticipated, motor notes were prominent; not rotational frequency or 120-cycle hum as might be expected, but higher-pitched notes of medium frequency range.

These notes seemed unusually loud, so the motor was removed from the unit and tested separately. It was very quiet. Next it was loaded by means of a small generator, but the increase of noise was slight. Next the fan was used, and up jumped the noise. It looked like the fan, and accordingly the fan was mounted on a shaft and run separately. The fan was also very quiet. These facts led directly to the solution. The fan had certain critical frequencies which were close to some of the motor notes, and acted as a loud speaker for them. Slight changes were made in the shape of the fan which had no effect on its size, weight, efficiency, or cost, but which did shift its critical frequencies away from existing vibrational components. Almost any motor could be used with this new fan, and the company stopped paying the premium for selected motors. Thus quieting was accompanied by a decrease in the cost of production.

It often happens that acoustical measurements yield unexpected but very definite information concerning the mechanism of a machine and indicate where improvements may be made to advantage.

The initial purpose of the work on a large reduction gear was to determine noise specifications for this type of unit so that a central-station company could include them in the order for their next turbo-

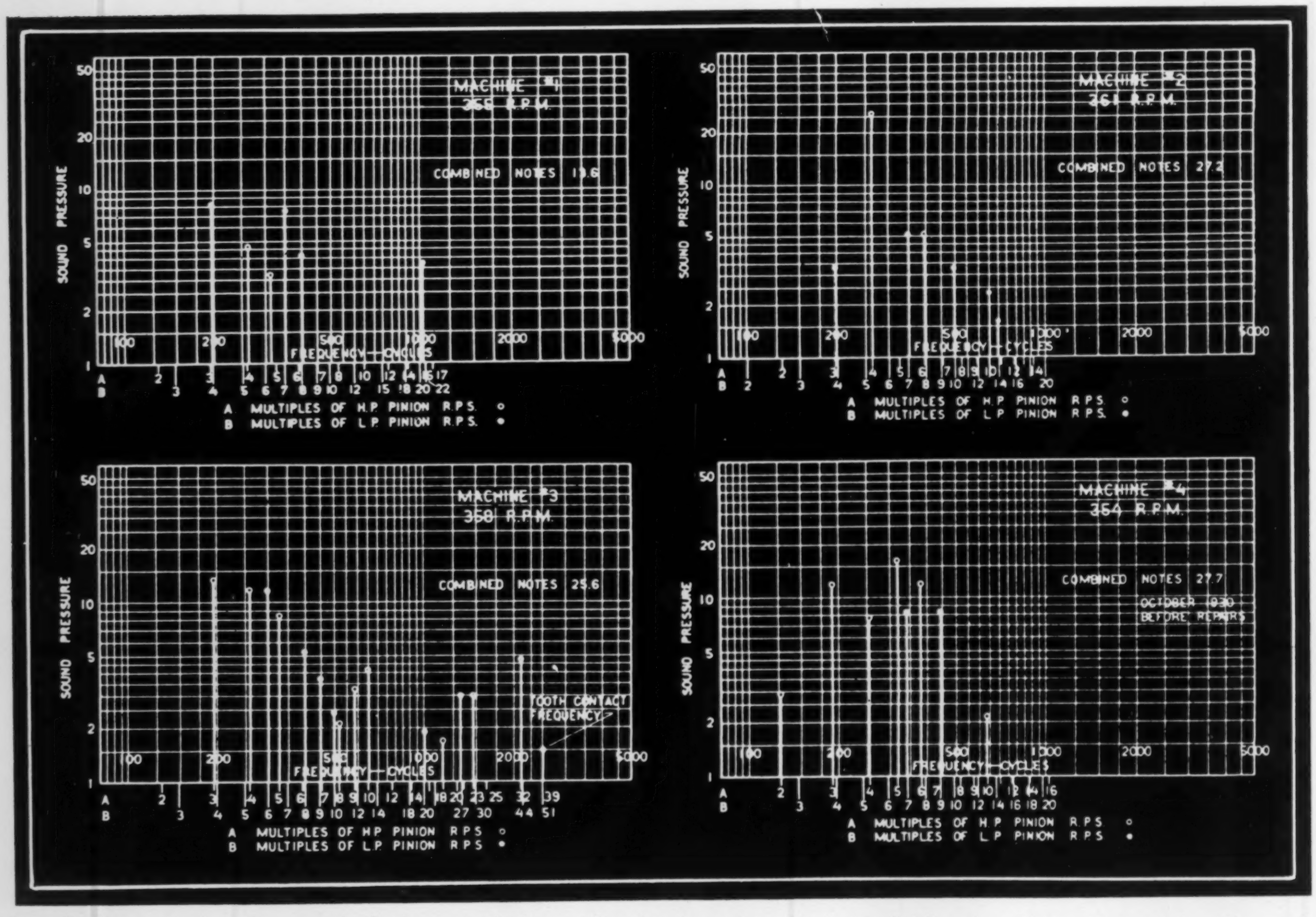


Fig. 2—Frequency analyses such as these made for a reduction gear give a basis on which noise elimination can be advanced

generator unit. While such specifications are entirely feasible, it is desirable to determine them on the basis of existing equipment rather than to write them entirely on the basis of personal opinion. To this end, both sound-level measurements and frequency analyses were made on a group of existing units. Typical frequency analyses are shown in *Fig.* 2.

Measurements showed that the machines had very prominent musical components. These notes were all harmonics of two fundamental frequencies. Surprisingly enough, these fundamental frequencies did not correspond to frequencies of tooth contact as in the case of automobile gears, but instead were related to frequencies of rotation. Each of these gear units consisted of a large bull gear meshing with two separately driven pinions. The two series of notes were harmonics of speeds of these pinions. No notes could be detected which corresponded to bull-gear rotation. Each different gear set showed an entirely different acoustical spectrum (although all notes were harmonics of pinion rotation). When one of the sets was reconditioned by taking a small cut from the working side of the teeth, the acoustical spectrum was entirely different from what it was before. From these observations we obtained the following:

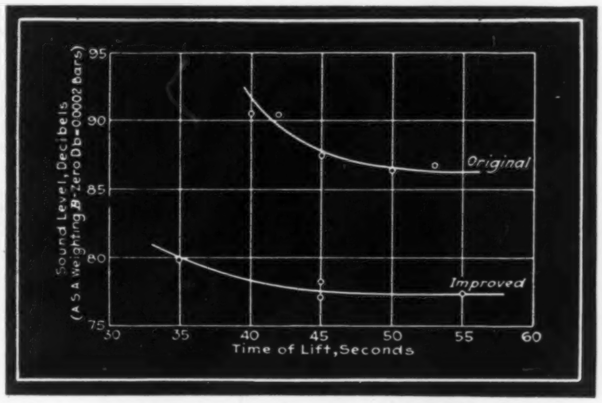


Fig. 3—Provision of a larger pump on lift trucks permitted the lowering of engine speed and reduction of sound levels

(a) Errors in tooth contour were not responsible for the noise. (Tooth-contact frequency was missing or negligible in this case.)

(b) Misalignment or deflection under load was not responsible for noise. (These would produce tooth-contact frequency.)

(c) Imperfect balance was not responsible for noise. (Fundamental rotational frequencies were missing.)

(d) The pinions were responsible for the noise, not the gear.

(e) The particular pinion responsible for each note was obvious.

(f) Notes were not caused by resonances of the shafts, webs, casings, etc. (Units with closely similar parts gave very different spectra. Even the same unit gave a different spectrum when the tooth surfaces were refinished.)

(g) This information indicated quite clearly that the errors causing the noise were produced by the machine on which the gears were cut, particularly the machine used in cutting the pinions. Further, the errors were not in the form of the cutter, but in the mechanism by which the blank was indexed from one tooth to the next, and by which the tooth spiral was generated.

In addition to the musical components just described, measurements showed that "unpitched sound" was prominent on several of the gear units. The reconditioned unit showed materially less unpitched noise than the others, indicating that roughness of the teeth was an important cause. Unevenly spaced irregularities on the bull-gear and other surfaces would also produce this type of noise.

Recently, the City of New York invited bids on a number of garbage dump trucks. Among the specifications was included a limit on the noise of the hoisting mechanism. This limit was of the order of 10 decibels quieter than those in present use.

New Pump Permits Lower Speeds

Fig. 3 shows a comparison of the noise of the present design and of a new design developed to meet the specifications. The measurements represent the average of readings at ten stations along the sides of the truck at a distance of one yard on the side of the body. It was found that the pump used on the original hydraulic lift produced prominent notes. Also the engine itself produced a higher level than was desired in the final installation. Since changes in the engine were not feasible, it was necessary to provide a pump of such a capacity that the lift could be made in the desired time with a much slower engine speed. In this way, the engine noise was reduced to the necessary value. The hoisting mechanism proper was quieted by means of an improved pump design and means for keeping the vibrations from being telegraphed to members which radiated them. The improvement in both the level and quality of sound was striking.

These examples of actual machinery-noise problems illustrate to some extent the variety of factors encountered in this field. It has become axiomatic with us that each new job involves different points of importance and requires different techniques of measurements.

The characteristics of any sound can be measured in about as much detail as one desires. Theoretically, perhaps, one might proceed in a routine manner to measure all the characteristics of each sound in which

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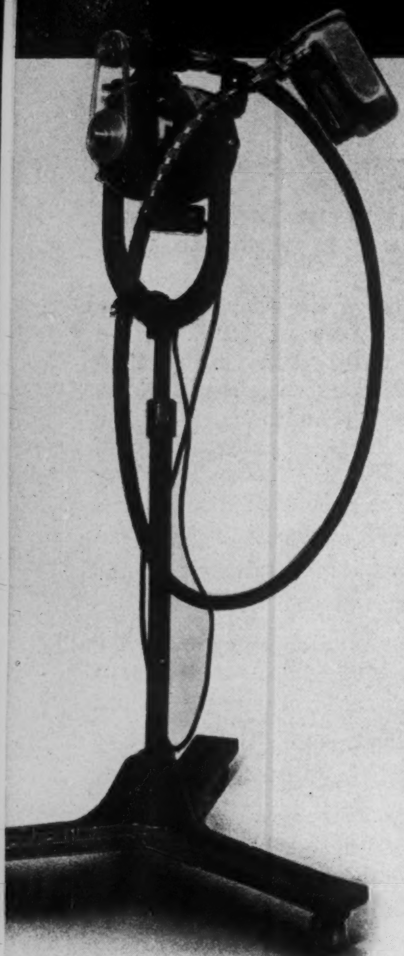
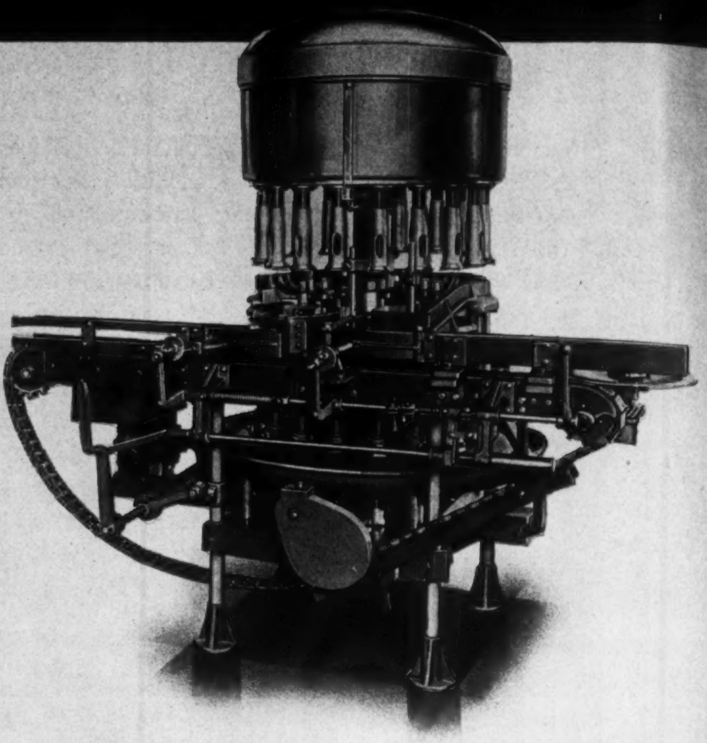


Completely built of stainless steel, the Horix bottle filling machine, right, is designed throughout to resist the corrosive action of the liquids being handled.



Action of Sterling electric sanding and rubbing machine, left, duplicates the reciprocal motion of hand operation. Flexible rollers of special composition rubber attached floatingly by pins to the sander block permit work on curved surfaces.

Design Fe
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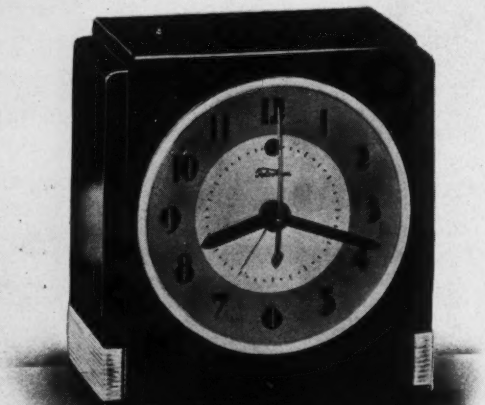
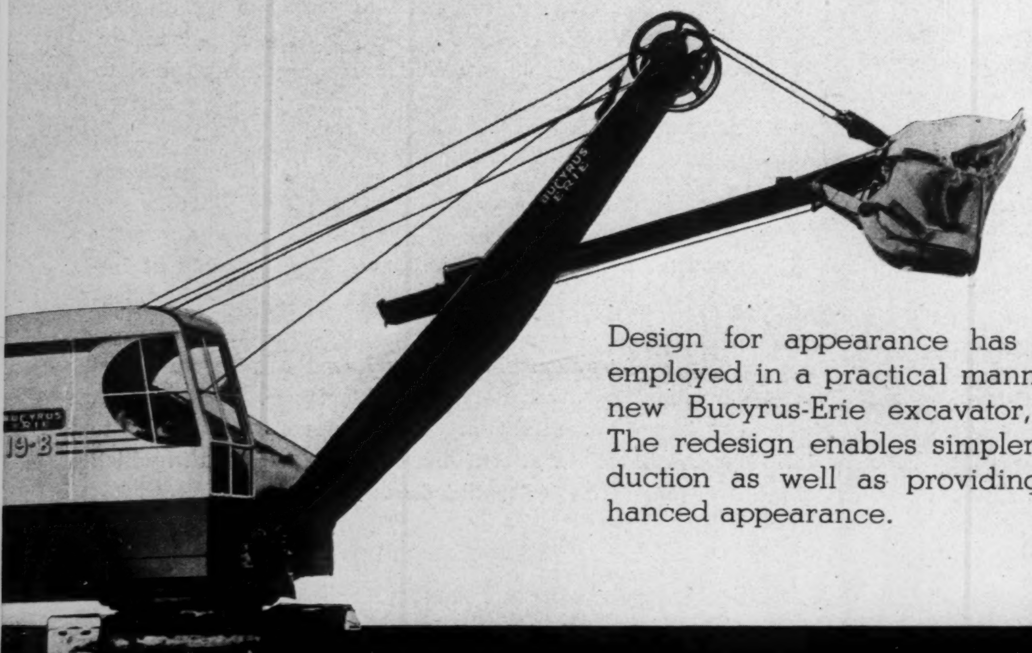
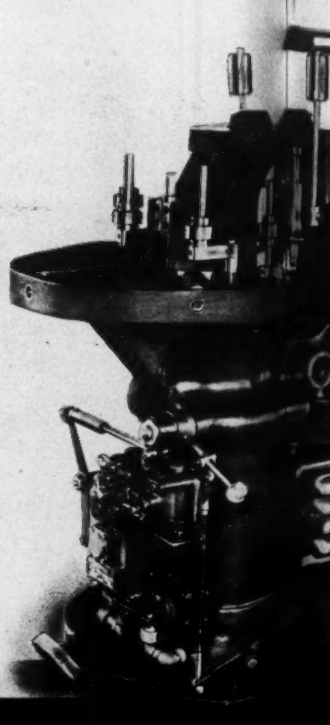
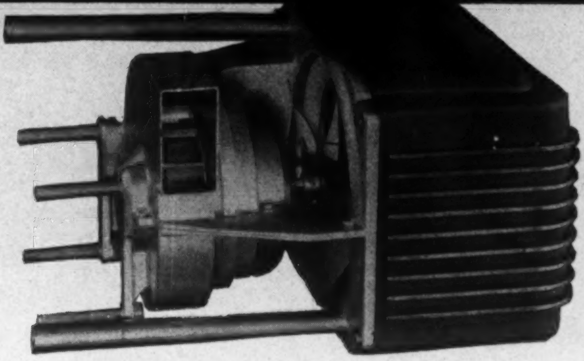


Molded plastic cases in black or ivory have been designed to fit Telechron clocks, right, into any decorative scheme. Mechanism of these clocks has been designed to operate without frequent attention of the user.



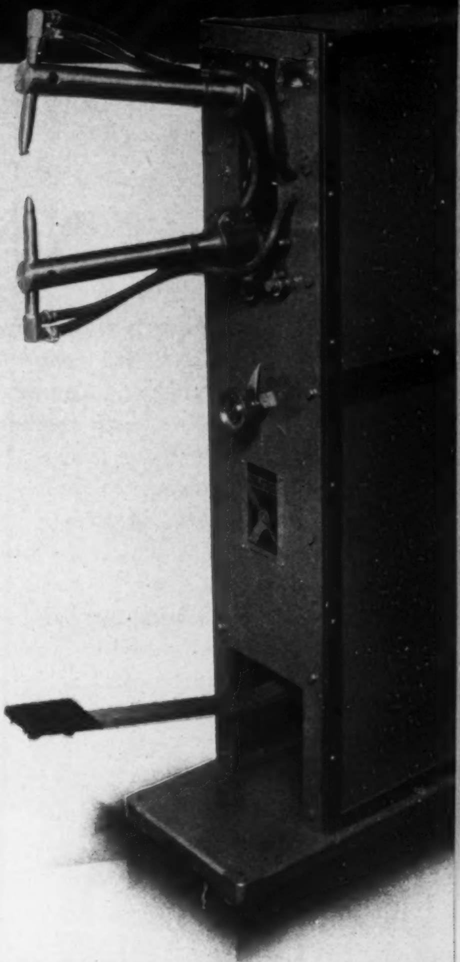
Design for appearance has been employed in a practical manner in new Bucyrus-Erie excavator, left. The redesign enables simpler production as well as providing enhanced appearance.





Aerotherm automobile unit, above, provides defrosting and heating in winter and ventilation in summer by the use of a fan and a blower built integral with the motor in a die cast case.

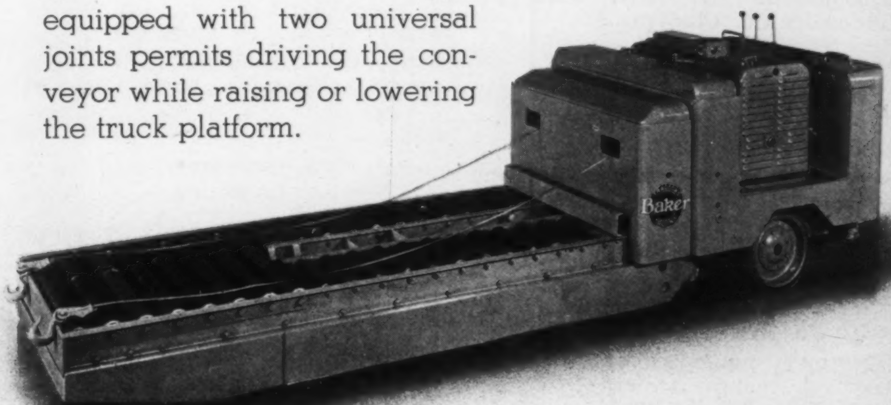
A single nut on the front of the unit adjusts welding pressure on this Armglo resistance welder, right. A built-in automatic timer accurately controls each weld. All of the several controls are completely enclosed in the machine.



Features
Machines

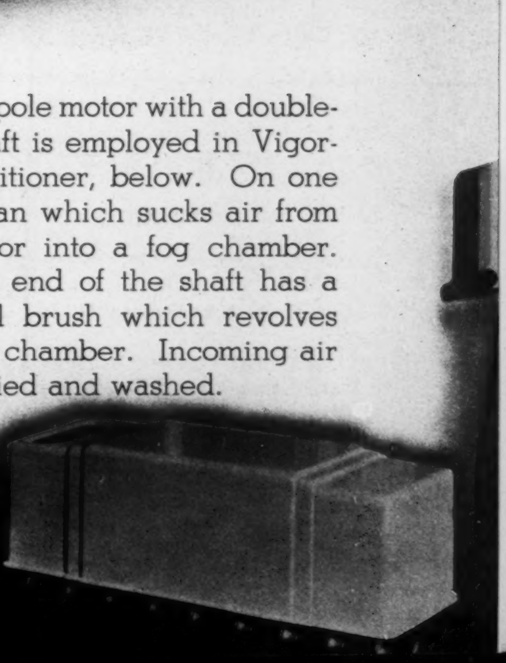
ation of Recent Machinery
andpoint of Design

A roller conveyor driven by an electric motor is an integral part of new Baker elevating truck, below. A long propeller shaft of the automobile type equipped with two universal joints permits driving the conveyor while raising or lowering the truck platform.



Complete hydraulic control, readily adjustable to handle washing machine tubs and beads of various sizes, features new McKinney machine, left. Each sequence in the operation can be independently adjusted by means of cam controlled valves.

A shaded pole motor with a double-ended shaft is employed in Vigor-Aire conditioner, below. On one end is a fan which sucks air from the radiator into a fog chamber. The other end of the shaft has a cylindrical brush which revolves in the fog chamber. Incoming air is humidified and washed.



New Machines Indicate Design Trends

There is no one material which will assure the designer of adequate protection against the action of corrosive forces. There is, however, a positive method of securing a material that will resist practically any corrosive substances that may be encountered in your machine. That method is the careful selection of alloying elements which, when added to standard materials, so improve their resistance that well-nigh absolute protection is assured.

Many of our standard alloys in daily use were originated by just such a method. The research work going ahead to find special materials for unusual conditions will bring out other standard alloys suitable for a wide range of applications. Designers are constantly adding to their knowledge of materials and the recent machines indicate that special materials are being more widely employed than ever before. It is far cheaper to use special materials than it is to lose sales of your machines!

Machines recently announced in addition to those on the preceding two pages include the following, arranged by fields of application:

Air Conditioning

Unit Conditioner, National Air Conditioning Inc., New York.

Motor-operated aspirating psychrometer, H. B. Instrument Co. Inc., Philadelphia.

Portable unit air cooler, Pamco Conditionaire Co., Chicago.

Construction

Pneumatic hammer, Master Tool Co. Inc., Cleveland.

Pneumatic concrete placer, Ransome Concrete Machinery Co., Dunellen, N. Y.

All purpose mixer, Blystone Mfg. Co., Cambridge Springs, Pa.

Center-line painting machine, White Mfg. Co., Elkhart, Ind.

Gyratory pulverizer with built-in vertical motor, McNally-Pittsburgh Mfg. Corp., Pittsburgh, Kans.

Dairy

Milk bottle inspecting equipment, Bottle Scope Mfg. Co., Philadelphia.

Domestic

Laundry dryer, Chadel Drying Co., New York.

Water circulator, Kainer & Co., Chicago.

Bin feed coal stoker, Anchor Stove & Range Co., New Albany, Ind.

Oil burning burner, United States Radiator Corp., Detroit.

Hot water generator, Nu-Way Corp., Rock Island, Ill.

Electrical

Bobbin, coil and armature winding machine, E. R. Seifert Inc., Syracuse, N. Y.

Food

Semi-automatic cereal puffer, Nu-Vita Foods Inc., Portland, Ore.

Evaporator for milk, fruit juices, syrups, tomato products, Oakland Copper & Brass Works, Oakland, Calif.

Foundry

Crucible type melting furnace, Philadelphia Drying Machinery Co., Philadelphia.

Industrial

Unit heaters, Unit Heater & Cooler Co., Wausau, Wis.

Power lift truck, Yale & Towne Mfg. Co., Philadelphia.

Unit heater, Air Devices Corp., Chicago.

Dryer for all types of plated work, Dellinger Mfg. Co., Lancaster, Pa.

Portable oil refiner, Luber-Finer Inc., Los Angeles.

Metalworking

Gear generating machine, Farrel-Birmingham Co., Ansonia, Conn.

Rod straightener and shear machine, American Foundry Equipment Co., Mishawaka, Ind.

Circular knife grinder, Samuel C. Rogers & Co., Buffalo, N. Y.

Brass die casting machines, Madison-Kipp Corp., Madison, Wis.

Hydraulic straightening press, Hannifin Mfg. Co., Chicago.

Double-end milling machine, Davis & Thompson Co., Milwaukee.

Mining

Pulsating jig for gold concentration, Pan-American Engineering Corp., Berkeley, Calif.

Packaging

Filling machine for powdered materials in measured amounts, Aurelio Tanzi Engineering Co., New York.

Two-station, auger type packer weigher, J. L. Ferguson Co., Joliet, Ill.

Restaurant

Electric, gas or steam twin coffee urn, S. Blickman Inc., Weehawken, N. J.

Electric glass washing machine, Reynolds Corp., New York.

Railway

Ice crusher-slingers for top icing, Link Belt Co., Chicago.

Textile

Embossing machine, Hinneken Machine Co. Inc., Paterson, N. J.

Welding

Portable arc welders, Harnischfeger Corp., Milwaukee.

Low range direct current arc welder, General Electric Co., Schenectady, N. Y.

Patent Centennial Calls Attention to Progress Through Invention

IN THESE columns and elsewhere have appeared criticisms, sometimes caustic, of the patent office and the patent system. Yet it is very evident that any system which can survive a hundred years with only minor changes is fundamentally sound.

Such a thought was expressed by many eminent leaders in industry who attended or commented on the centennial of the American patent system held November 23 in Washington. The tornadic progress made in this country during the relatively short hundred years—in relation to other countries—was referred to as one of the attributes of the course followed in regard to patent protection. As T. J. Watson, one of our foremost industrialists, said, "Our American system of invention, science, engineering, finance and management has given the peoples of the world more comfort and convenience in the past one hundred years than was given during the previous fifty centuries."

Yet inequalities, irregularities and confusion are bound to exist to some extent in any method of procedure that functions for an entire population. Constant refinement in detail is essential. That this is recognized by MACHINE DESIGN in connection with patent procedure is evidenced by the attention it devotes to the subject. Even in this issue appears an article dealing with a change in patent interference rulings that will obviate extraordinary hardship. It is only by bringing such conflicting matters into the open, by presenting them clearly and impartially that the utmost benefit can be derived from a system already well-nigh invaluable.

• • •

Position Reversed!

NOT for years have so many requests been received by MACHINE DESIGN for information on men available for positions in engineering departments. The openings are not for any single classification of job—chief engineers, designers, draftsmen, research engineers, all are needed. Contrasted with the condition during the early 1930's the situation now is significant of what may be expected in the increasing quest for skill in design.

Engineering employment agencies, classified advertisement sections and even "want ad" columns tell the same story of the almost breathless search for good designers. And this search, we venture to forecast, will continue unabated for the very reason that the trend in all industry toward higher wages for less hours of work makes new, even more highly-productive machinery the only salvation for manufacturing companies throughout the country.

It will pay the heads of engineering departments and other executives to study—now—their engineering department personnel requirements and probable future needs!

TORCH cutting and gas welding have progressed well into the field of accepted production processes. As such, they have become the subject of careful attention by the designer of all types of machines. The accompanying article, abstracted from papers presented at the recent meeting of the International Acetylene association, indicates that considerable design standardization is necessary so that the development engineer can be certain the cause of failure does not lie with his design.

Design Is Blamed for Weld Failure!

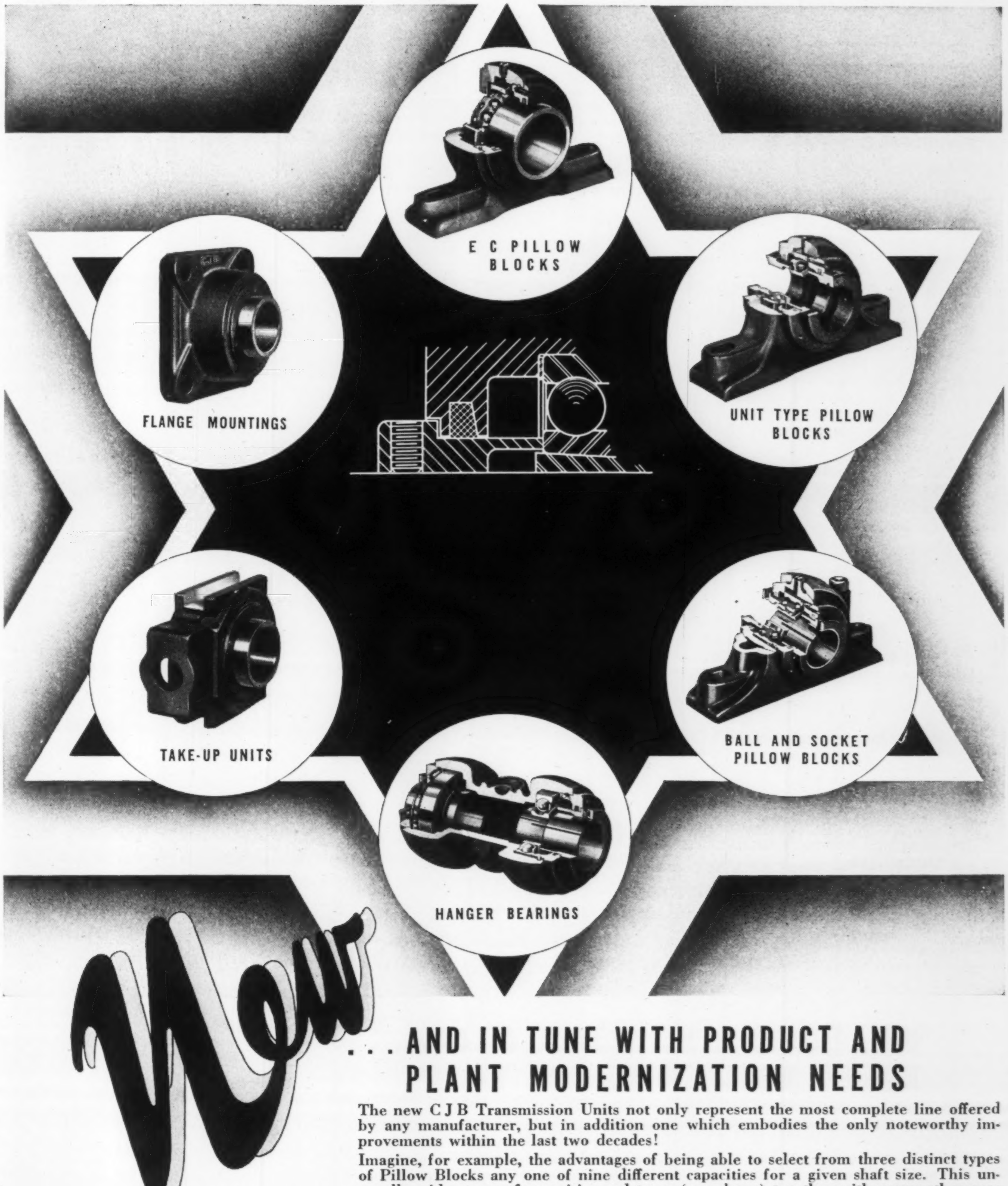
NINE times out of ten the failure of a weld is due to the design and not to the welder," according to R. G. Le Tourneau, president of R. G. Le Tourneau Inc. The author also believed that if we design all our welds so that if the actual weld is 50 per cent weld metal there will be more strength than required. In other words, we would not think of butting two bars together and making a flush weld just the size of the bars unless we knew that the strain would be less than half the strength of the bar. If the strain is to be greater than that we would simply strap it so as to get more weld.

Another thing that must be borne in mind to properly design a welded structure is that a three-eighths weld is fully half as strong as a three-quarter weld, but it only has one-quarter as much metal in it and can be put on more than four times as fast by using a strap, or by lapping the pieces as has to be done in a riveted job. It is possible to obtain a full strength union with almost any size weld one desires to use, and it only becomes necessary to find the happy medium between the length of strap and size of weld.

A big advantage of welding is that different types of metals can be used in the same unit; for instance, we make an 18-inch ring gear with a heavy hub in it. The hub is formed cold in a press out of mild steel, while the disk is made of a strong alloy. The rim is rolled out of a bar of alloy steel which is suitable for carburized gear teeth. In a casting or a forging it would be necessary to use the more expensive metal throughout. The rim of this gear is welded to the disk, and the joint where the bar comes together is welded on the inside of the rim but not on the outside. There is a crack left in the rim at the depth that the tooth is going to be cut and this crack is cut out by the gear machine; so there is no crack in the finished gear, neither is there any welding metal in the tooth of the gear.

Supplementing Mr. Le Tourneau's discussion of welding, Charles H. Ellaby of the United States Engineering department stated that a condition of primary importance toward the adoption of welding is that established fabricators shall be thoroughly cognizant of sound welding construction practice. Also, the fact must be developed and the knowledge so disseminated as to create complete confidence in the designers that welded connections develop the full strength of the parent metals.

Further, there must be developed and thoroughly disseminated to the engineering profession complete comprehensive technique and methods for design and construction sequence which will provide for shrinkage and distortion factors and the elimination of unduly costly temporary fabrication or creation facilities. Summed up, it appears that a diligent and united effort in the promulgation and effective dissemination of a complete comprehensive educational program by the welding fraternity is mandatory in the successful promotion of welding. This is no far-fetched theory, as the writer has very recently discussed the subject with some of the foremost heavy structure fabricators and contractors in the nation and discovered a somewhat amazing ignorance or inertia with regard to welded structures.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MEN of MACHINES

ELECTION of Frank M. Farmer as chairman of the Engineering Foundation brings to the head of this research organization of the national engineering societies an authority on testing of engineering materials and on electrical measurements. Mr. Farmer was born in Ilion, N. Y., in 1877, graduated in mechanical engineering at Cornell University in 1899 and then began work as student engineer at the General Electric Co., Schenectady. He then became an inspector for the Navy department in Brooklyn. From 1902 to 1906 he was a lecturer at Cooper Union.

Since 1903 Mr. Farmer has been associated with the Electrical Testing Laboratories, New York, of which organization he is vice president and chief engineer. He is a past president of the American Society for Testing Materials and of the American Welding Society.

Frank M. Farmer

• • •

FOR his outstanding work in formulation of codes and procedures which have made fusion welding acceptable, Dr. David S. Jacobus, whose experience with the oxyacetylene process began in 1897, has been awarded the Morehead medal by the International Acetylene association. Born at Ridgefield, N. J., in 1862, Dr. Jacobus graduated from Stevens Institute in 1884. He remained there teaching experimental mechanics and engineering of physics until 1906 when he joined Babcock & Wilcox Co. as advisory engineer. He now heads the engineering department of that company.

Dr. Jacobus' service with professional societies is no less distinguished than in engineering teaching and practice. Three times president of the American Welding Society, he also is past president of the American Society of Refrigerating Engineers and of the American Society of Mechanical Engineers.

David S. Jacobus

• • •

APPOINTMENT of Carl J. Fechheimer as consulting engineer with the Louis Allis Co., Milwaukee, brings into that organization an engineer whose primary interest since the turn of the century has been in the design of electrical machinery. Following graduation from the Technical High School of Cincinnati in 1899 Mr. Fechheimer spent considerable time in the shops and testing departments of the Triumph Electric Co. and the Bullock Electric Co., in the meantime continuing his studies. He graduated in electrical engineering from Purdue in 1904, then studied at Cornell.

Between 1905 until 1910 he was a designer of alternating current machinery with the Bullock Electric Co. and with Allis-Chalmers. Then followed nearly five years of similar work with Crocker-Wheeler. Mr. Fechheimer joined the Westinghouse organization at the end of 1914, remaining

Carl J. Fechheimer

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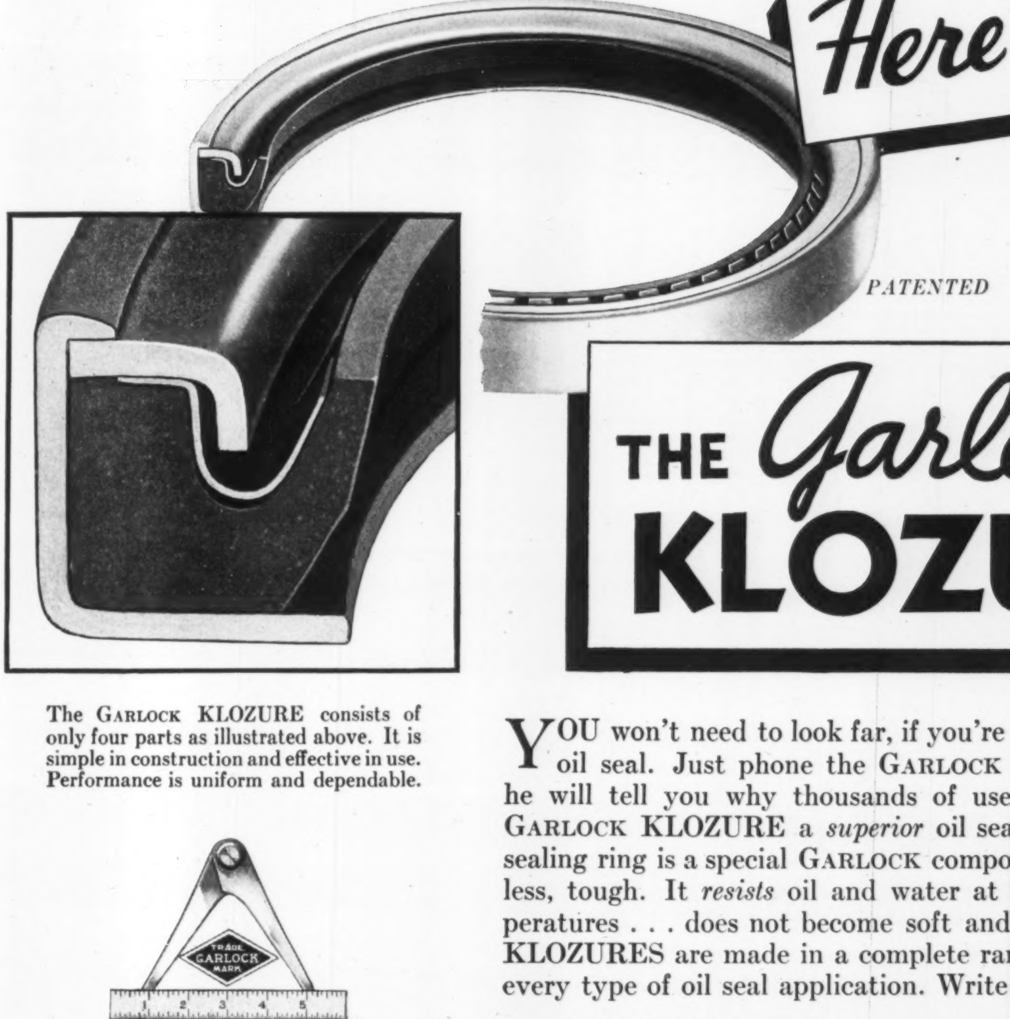

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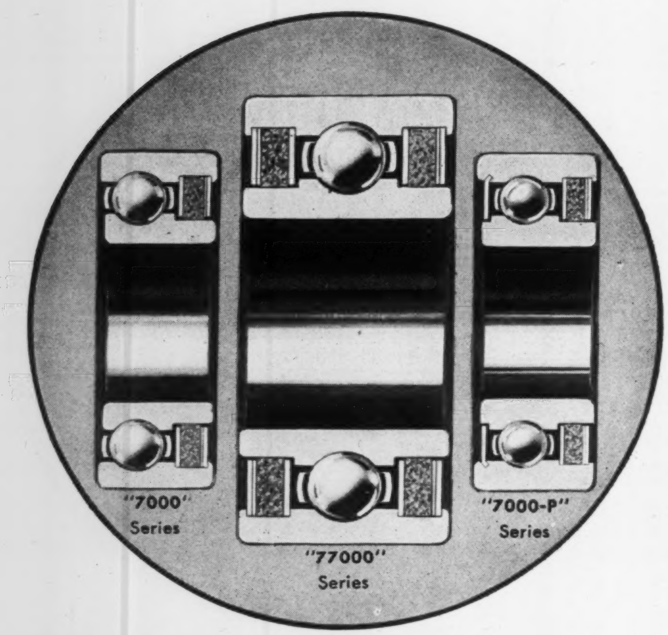

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with that company until June, 1931, when he established himself as a consulting engineer in Milwaukee.

As a research engineer with Westinghouse, Mr. Fechheimer devoted much time to solution of problems of heating in electrical machinery, this involving experimental and analytical studies of heat transference and ventilation—including hydrogen cooling.

◆ ◆ ◆

C. H. KINDLE, formerly chief engineer and later factory manager, has been appointed general manager of the Delco Products division, General Motors Corp., Dayton, O., succeeding FRANK H. PRESCOTT who is now vice president and general manager of the Electro-Motive Corp., La Grange, Ill., builder of diesel-electric locomotives.

◆ ◆ ◆

H. H. ERKELENZ, who has been connected with the Harnischfeger Corp., Milwaukee, for twenty-five years, has been promoted to the position of manager of engineering and works. Mr. Erkelenz became assistant works manager in 1925 and works manager in 1933.

◆ ◆ ◆

JULIAN M. AVERY, electrochemical and metallurgical engineer, formerly with Union Carbide & Carbon Corp., has joined the staff of Arthur D. Little Inc., Cambridge, Mass.

◆ ◆ ◆

N. W. STORER, widely known authority on railway electrification, has retired after forty-five years of service with Westinghouse Electric & Mfg. Co. At the time of his retirement he was consulting railway engineer with the company.

◆ ◆ ◆

AMBROSE SWASEY, surviving founder and present chairman of the Warner & Swasey Co., Cleveland, has been presented the Hoover Gold Medal " . . . . awarded by engineers to a fellow engineer for distinguished service." Mr. Swasey is justly called the dean of machine tool builders, his 90th birthday being December 19.

◆ ◆ ◆

STANWOOD W. SPARROW has been appointed research engineer for the Studebaker Corp., South Bend, Ind.

◆ ◆ ◆

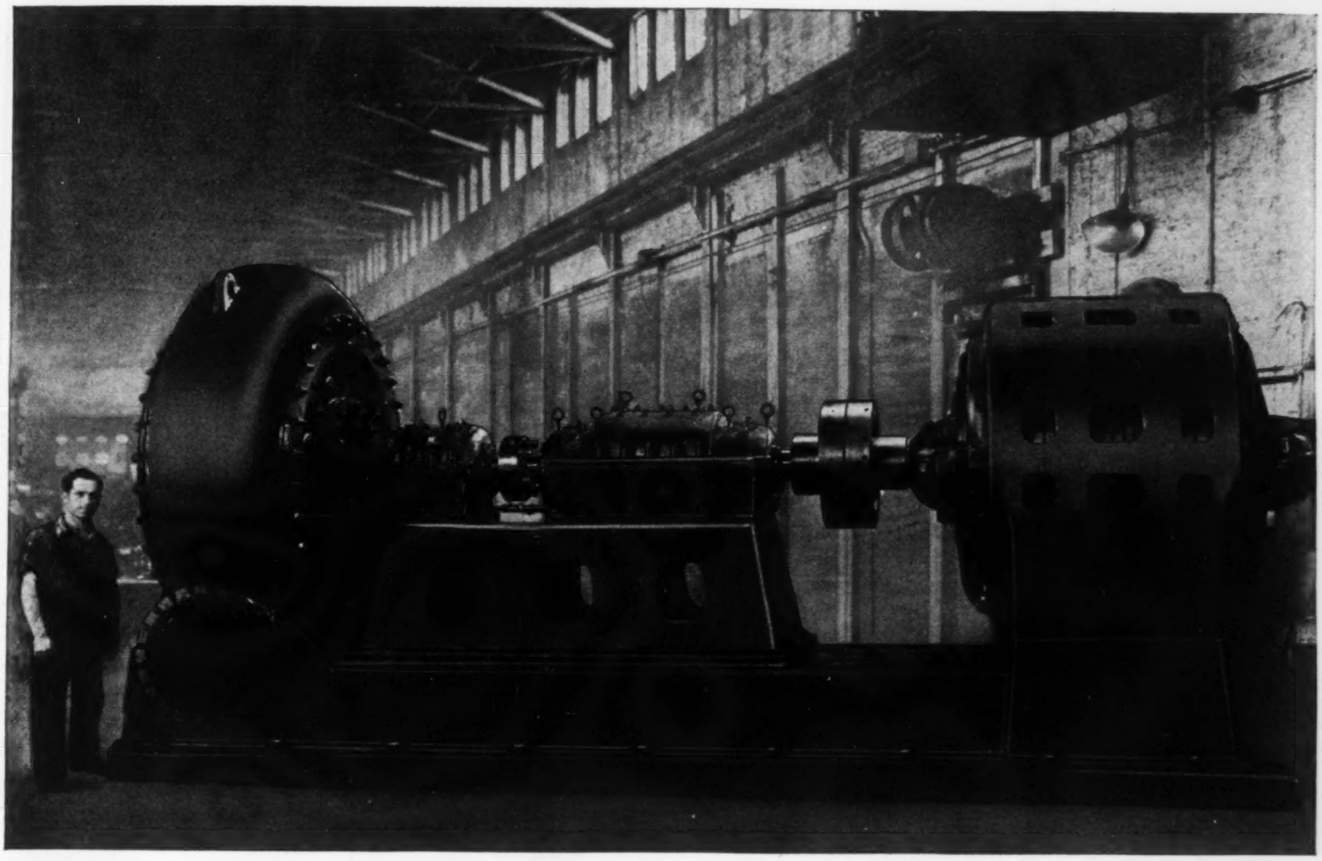
CHARLES F. KETTERING, vice president in charge of research, General Motors Corp., has been elected a director of the National Cash Register Co.

◆ ◆ ◆

D. G. ROOS, who several months ago resigned as vice president in charge of engineering of Studebaker Corp. because of ill health, has rejoined that company as technical advisor, with headquarters in South Bend, Ind.

◆ ◆ ◆

PROF. ELIHU THOMSON, noted electrical scientist, recently has been the recipient of honors and congratulations on the occasion of the fiftieth anniversary of his invention of the resistance welding process. Professor



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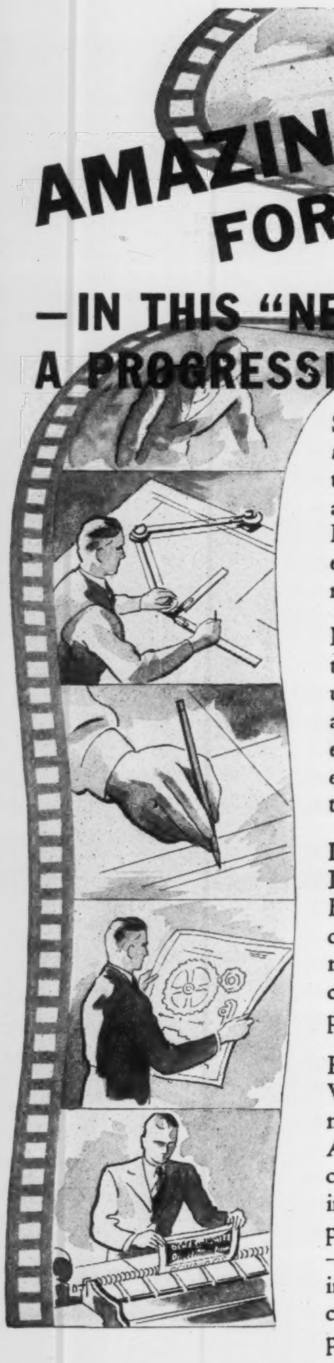

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Thomson, now eighty-four years of age, was one of the founders of what now is the General Electric Co.

◆ ◆ ◆

CARL W. FLOSS, formerly design engineer with Hoffman Motor Development Co., is now engaged in independent research work with offices in Detroit.

◆ ◆ ◆

FREDERICK SALDITT has been appointed vice president of the Harnischfeger Corp., Milwaukee. Mr. Salditt has been connected with the company for thirteen years. He is a mechanical engineer, having graduated from the Technical University of Darmstadt, Germany.

Obituaries

JAMES A. HALL, professor of mechanical engineering at Brown University, died at Providence on Oct. 29, at the age of 48. Professor Hall, who was born in Berlin, Vt., attended school at Providence and received his degree of Bachelor of Science in Mechanical Engineering from Brown University in 1910. He joined the faculty at Brown in 1914, being recognized as an authority on machine design, in which field he did notable work as a consulting engineer.

Professor Hall was a dynamic personality and gave liberally of his time and talents to the cause of organized engineering as exemplified by the professional societies. He was a past president of the Providence Engineering Society, chairman of the New England division of the Society for the Promotion of Engineering Education, and member of Council and vice president-elect of the American Society of Mechanical Engineers.

With the untimely death of Professor Hall, the technical press—including MACHINE DESIGN—loses a frequent and high respected editorial contributor.

◆ ◆ ◆

JAY ROBERT MCCOLL, dean of the college of engineering, University of Detroit, since its inception in 1911, died recently in Detroit. After graduating in mechanical engineering at Michigan State college in 1890, he did postgraduate work at East Lansing and Cornell. He then became professor of engineering and head of the mechanical engineering department at the University of Tennessee, and later was head of the steam engineering department at Purdue.

Professor McColl made his mark in industry as well as in teaching—having been for several years chief engineer of the American Blower Co., Detroit, a member of the consulting engineering firm of McColl, Snyder & McLean and one of the editors of the *Michigan Architect and Engineer*. He was a past president of the Detroit Engineering society and active in the affairs of the American Society of Heating and Ventilating Engineers and the American Society of Mechanical Engineers.

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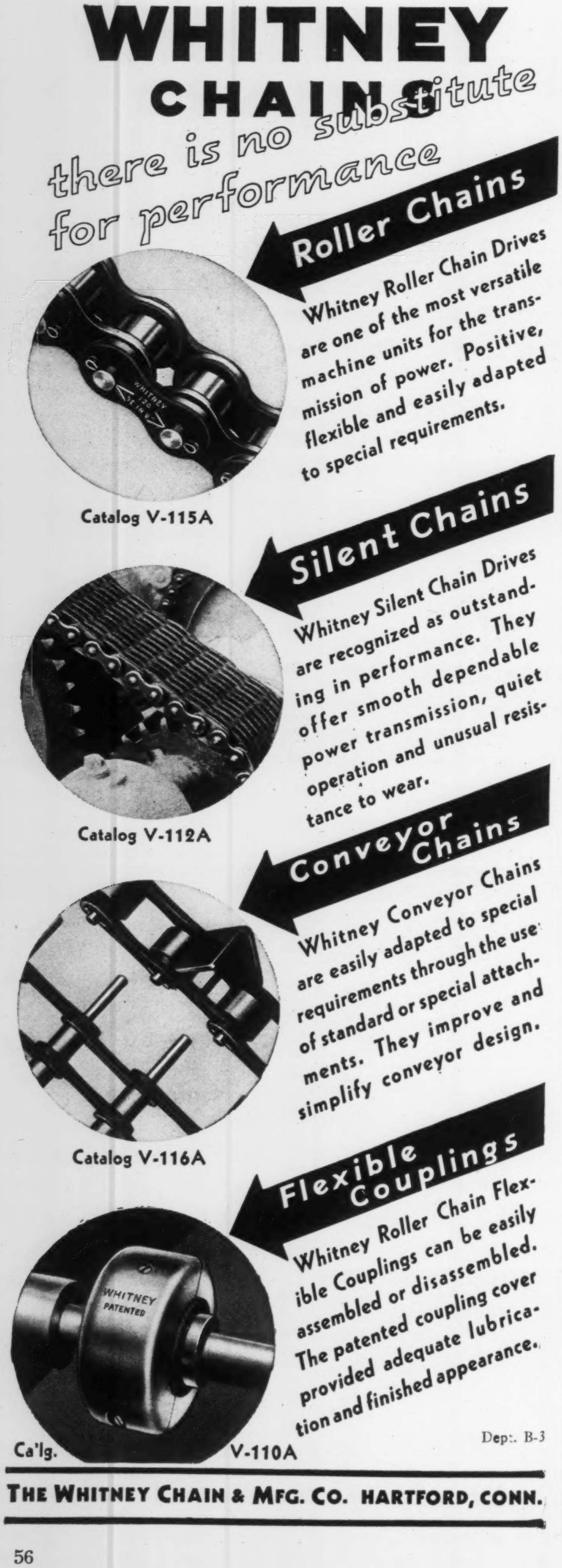

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Noteworthy Patents

PATENT No. 2,022,645 granted to George S. Baldwin, Cleveland Heights, O., assignor to American Laundry Machinery Co., covers hydraulic control of garment pressing machines. The system embodies dual valves requiring both hands on the controls throughout the closing cycle. This prevents the operator from getting them caught in the press.

The hydraulic system is shown diagrammatically in *Fig.* 1, *A* being the main fluid motor actuating the closing mechanism of the press. The press will not close unless cap lever *B* is swung to bring its cap *C* directly over ball end *D* of thrust rod *E*, thus coupling thrust rod to head lever *F*. This is accomplished by a secondary fluid motor *G*, mounted on the underside of head lever *F* and with its piston rod linked to the lower arm of swinging cap lever *B*. When motor *G* is not energized, spring *H* pushes the piston up, uncoupling the operating mechanism.

Line *J* is a combined supply and exhaust conduit between coupling motor *G* and operating valve casings *K* and *L*, which are connected in series. Valve casing *L* in turn connects with pressure fluid supply line *M*. The

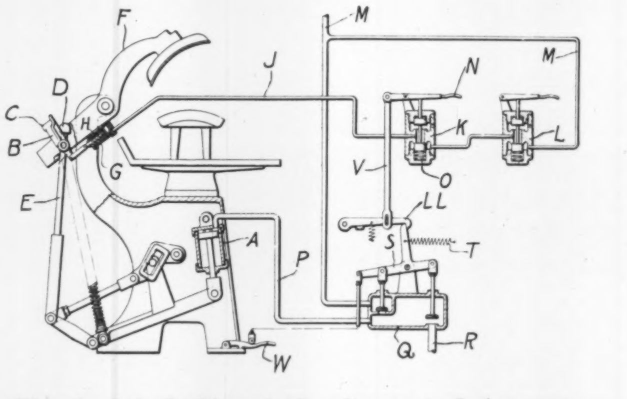

Fig. 1—*Interlocking hydraulic control for garment press protects the hands of the operator*

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Your "special" job may be an IXL *standard.* The largest and finest equipped gear production plant in the world. Exclusive and rigid testing methods that insure against faults. A factory staff, many of whom have spent a lifetime producing gears for every industrial application.

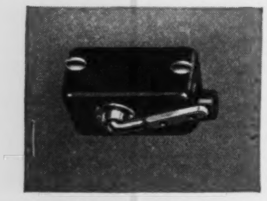
A New Line

Now available a complete line of IXL Fractional Horsepower Powered Gears, sizes 1/50 H. P. to 3/4 H. P. Ratio 2 to 1 to 8000 to 1. Send for Bulletin 750.

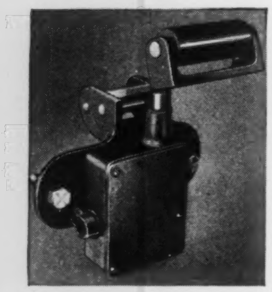
FOOTE BROS. GEAR AND MACHINE CORPORATION
5303 South Western Boulevard Chicago, Illinois

Sensitive Switches

for REMOTE CONTROL and OPERATION of ELECTRIC COUNTERS



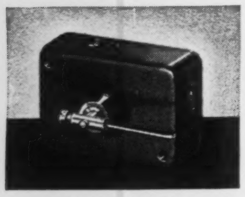
Type ES-1 Heavy Duty Switch, single contact. Sheet steel case.



Type ES-7C Case Counting Switch for use on conveyor. Cast brass case.

Production Instrument Chicago

Type ES-41 Switch with spring operating arm.



Type ES-9 Pilot Switch with extremely sensitive action. Bakelite case.

● Accurate production counting, often under conditions that prohibit the use of mechanical counters, is provided by a simple installation of electric counters and the proper type of contact switch. Production Instrument Sensitive Switches are available in many types, in capacities from 1/2 ampere to 5 amperes, for a wide variety of remote control, signaling, and similar uses, as well as for operation of electric counters.

Production Instrument Sensitive Switches are built to withstand continuous high speed operation under industrial plant conditions. Contact points are Fine Silver, contact springs of phosphor bronze. The types illustrated are but a few of the many standard types available.

Write for data sheets illustrating other types, and recommendations on suitable switches for any particular requirements.

☆

PRODUCTION INSTRUMENT COMPANY
1319 South Wabash Avenue, Chicago, Illinois

Manufacturers of Precision Counting and Recording Devices and Sensitive Switches

lower valve in casing K is a normally closed inlet while the upper one is a normally open exhaust. They are on a common stem connected to hand lever N and held in their normal position by spring O. Casing L is a duplicate of K except for its operating lever.

Pressure fluid is supplied to main fluid motor A by combined supply and exhaust conduit P connecting with valve casing Q containing at the left a normally closed inlet valve communicating with pressure fluid supply line M, and at the right a normally open exhaust valve discharging through drain R. These valves in Q are linked to pivoted actuator S so that when one is open the other is closed. A vertical arm of actuator S is pulled toward the right by spring T, but latch U normally limits this movement, preventing throwing of the valves in Q to "fluid supply" position. Slotted link V connects latch U with hand lever N in such a manner that the valves in casing K operate before the slotted end of the link V contacts the pin in U, thereby unlatching actuator S and causing the valves in casing Q to be moved to "fluid supply" position. The diagram merely indicates a connection between treadle W and actuator S by means of which the valves in R are returned to and latched in "fluid exhaust" position against the pull of spring T.

The operator arranges the garment on the press bed. Then, using both hands, he simultaneously presses down the levers on K and L. The initial result is that the outlet valves in K and L close and the inlet valves open, whereupon pressure fluid flows from conduit M through casings L and K, thence through conduit J to operate secondary fluid motor G. This swings cap C of lever B over ball end D of thrust rod E, which couples the press linkage. Then as lever N is further depressed, latch U is lifted, releasing actuator S and causing the valves in casing Q to be shifted to "fluid supply" position. Thereupon, pressure fluid from conduit M flows through casing Q and conduit P energizing primary fluid motor A. This closes the press, provided that both hands remain on the levers until the end of the cycle.

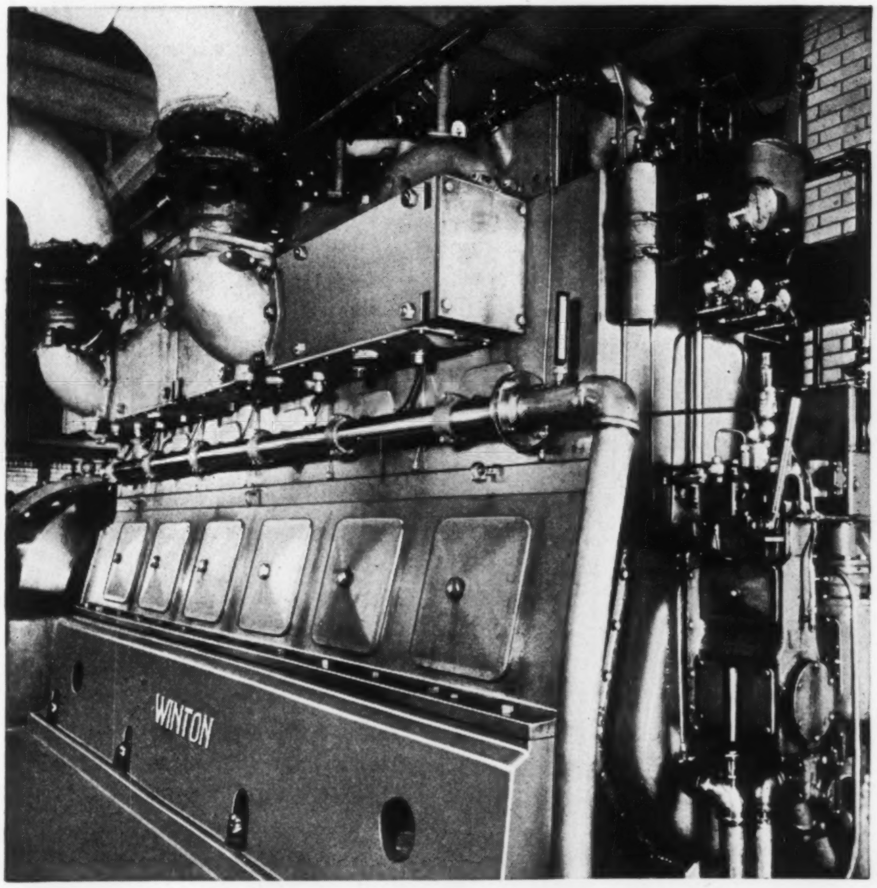
If one or both hands be removed prematurely, pressure to motor G is cut off, reaction of spring H forces cap C off ball end D and the press flies open. After a complete closing, however, the hands can be removed from both levers and the press will remain closed until released by pressure of operator's foot on treadle W.

DESIGNED to prevent entrance of water and other extraneous matter, a unique type of dynamo-electric machine housing has been patented by Leroy F. Keely, Milwaukee. This patent, No. 2,055,931, has been assigned to the Louis Allis Co. of Milwaukee.

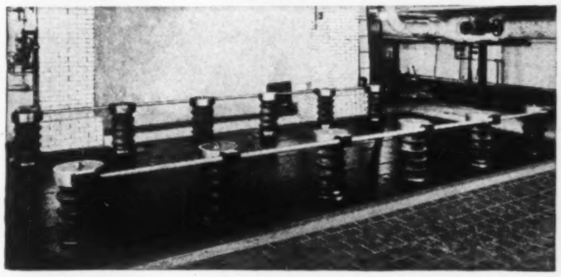
The improvement, which relates either to generators or to motors, provides free air ventilation but at the same time affords complete splash protection. *Fig.* 2, of

160,000 pounds of Diesel Engine

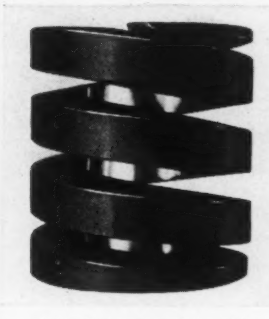
float on Springs of Steel



Here is one of the most outstanding Diesel installations ever made in this country. This huge engine is mounted on a slab which floats on 12 steel springs.



Spring bases in position ready for forming of floating slab upon which the engine is mounted.



Type of spring used for this installation.

HERE is a revolutionary step in absorbing the excessive vibration of moving machinery. This huge Diesel engine located in the modernized Singer Building Power Plant in New York City and weighing 160,000 pounds is mounted on twelve steel springs.

Steel Springs were installed in preference to organic material which has been in general use, because they give freedom from chemical and mechanical disintegration, have unchanging operating characteristics and afford the possibility of predetermining vibration characteristics by precise mathematical calculation.

Important is the fact that the trained technical staff of the American Steel and Wire Company was called upon to design the springs which made this feat possible. Springs for such purposes represent the best in combining engineering with workmanship to impart the desired dynamic and static properties to the mounting for the successful elimination of vibration.

This highly trained technical staff of the American Steel and Wire Company is prepared to work with you in the application and design of steel springs for overcoming vibration and in all situations where valuable advice on springs is necessary.

U·S·S AMERICAN QUALITY SPRINGS

AMERICAN STEEL & WIRE COMPANY

208 South La Salle Street, Chicago

Empire State Building, New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

INVENTION
and the
LAW
TOULMIN

INVENTION and the LAW

Harry Aubrey Toulmin, Jr.
J. D., Litt. D., LL. D.
Member A. S. M. E., Franklin Institute, S. A. E., etc.

HERE is a much-needed, practical manual on patentable invention for the use of engineers and executives, as well as for attorneys, by a writer experienced in this field. It is a complete desk manual on how to determine invention.

What is Design that is not Invention? What is Invention? This new book enables you to find quickly a clear and understandable statement of the RULES on each invention question. These rules are based upon decisions of the Supreme Court of the United States. They are accurately stated in simple and understandable language for engineers and executives.

This book answers questions as to how invention is determined; explains invention rules in other countries; what you must do to determine the patentability of inventions. It contains exhaustive indexes of every rule involving invention with a complete list of books and magazine articles in English, French and German on invention.

You may order *Invention and the Law* for five days free approval. At the end of that time, return the book to us, or remit $5.00. 347 Pages, 6 x 9 inches.

PRENTICE-HALL, Inc.
Dept. IP-19 70 Fifth Ave.
New York, N. Y.

which the lower view is a perspective of the cover plate at the output end of a motor while the upper is a horizontal section through the same end of the machine, gives an idea of how the splashproof ventilation is accomplished.

Referring to the lower view, it will be seen that while the bell-shaped cover plate is open at the bottom at *F*, a series of baffles provide a tortuous passage. While this allows free flow of air to the interior of the machine, solids or liquids are promptly trapped and deflected. The system includes an elliptical chamber *A* bounded by an inner transverse wall *B* which is a part of dish-shaped wall *C*, an outer transverse wall *D* and a side wall *E* connecting the transverse walls. At the bottom of the chamber wall *E* is cut away to provide opening *F*, already mentioned.

Communication is established between the air chamber and the interior of the machine through an opening *G* in the inner transverse wall *B*, this opening being located in the upper portion of the air chamber. It will be noted that bearing housing *H* extends across the space between the transverse walls *B* and *D*. Below this bearing housing is a baffle wall *J* which with the inner and outer walls and the bearing housing forms two collecting chambers in which liquid deflected from the upper portion of side wall *E* accumulates to be drained through openings *L*. Inclined lips *M* at the extremities of inner wall opening *G* play an active part in deflecting direct and indirect splash. The cover plate at the back of the motor is of the same construction except that the armature shaft does not pass completely through.

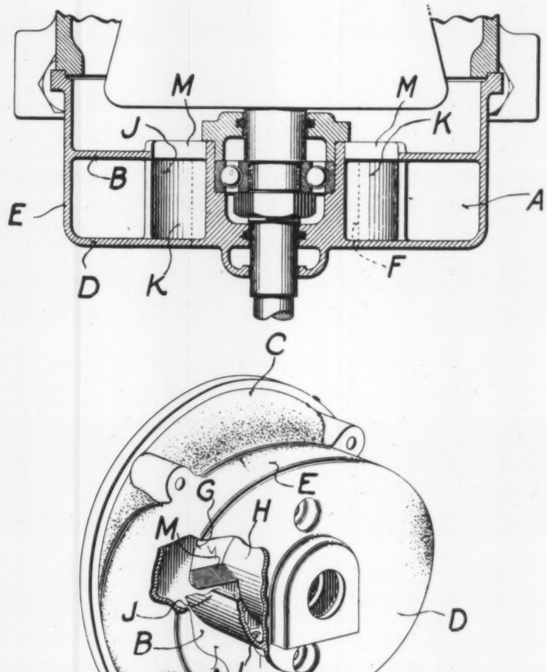


Fig. 2—Labyrinth system allows free flow of air through motor but prevents entry of water

THE Proprietor EATS IN ANOTHER RESTAURANT

IT'S an old quip . . . about the restaurant proprietor who steps out for his lunch. But its implication is deadly—he doesn't eat his own food.

We manufacture motors. We also manufacture the most diversified line of machinery of any company on the American continent, and that machinery is driven by the motors that we build . . . by Allis-Chalmers motors.

The Allis-Chalmers Mfg. Co. builds standard motors of every type from 1 hp. up—also motors for special applications

All the engineering skill and ability that have gone into the development of that vast and distinguished line of mechanical and electrical machinery have contributed to the development of Allis-Chalmers Motors; for our policy is one of undivided responsibility and the highly specialized knowledge and experience of every department is exchanged with that of every other department where it may have any bearing. It is from this wide and varied background that we designed and developed Allis-Chalmers Motors specifically for industrial application.

Allis-Chalmers Motors excel because they are the sturdiest motors on the market today—bar none. And they are the most profitable motor buy on the market today—bar none, because their great mechanical and electrical strength reduces maintenance costs to the minimum and extends their life beyond that of all less sturdily constructed motors.

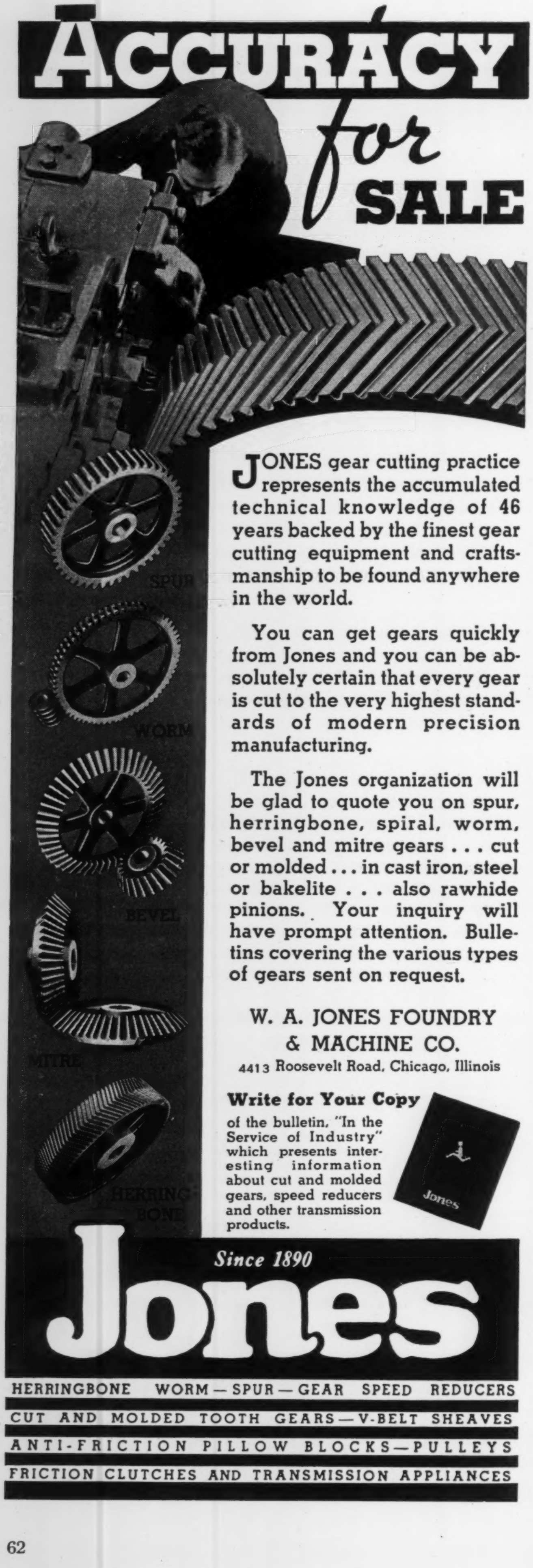
651

MOTOR DIVISION

ALLIS·CHALMERS

FOR EVERY PURPOSE

MILWAUKEE WISCONSIN



ACCURACY for SALE

JONES gear cutting practice represents the accumulated technical knowledge of 46 years backed by the finest gear cutting equipment and craftsmanship to be found anywhere in the world.

You can get gears quickly from Jones and you can be absolutely certain that every gear is cut to the very highest standards of modern precision manufacturing.

The Jones organization will be glad to quote you on spur, herringbone, spiral, worm, bevel and mitre gears . . . cut or molded . . . in cast iron, steel or bakelite . . . also rawhide pinions. Your inquiry will have prompt attention. Bulletins covering the various types of gears sent on request.

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Write for Your Copy of the bulletin, "In the Service of Industry" which presents interesting information about cut and molded gears, speed reducers and other transmission products.

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HERRINGBONE WORM—SPUR—GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS—V-BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS—PULLEYS
FRICTION CLUTCHES AND TRANSMISSION APPLIANCES

Assets to a Bookcase

Die Castings

By Charles O. Herb; published by the Industrial Press, New York; available through Machine Design *for* $3.00 *plus* 15 *cents postage.*

One of the significant developments in modern manufacturing is the wide application being made of the greatly improved die castings now available. In order most effectively to take advantage of die castings in design, engineers should be familiar with the possibilities of this process. This book covers die casting from its earliest phases up to the most advanced modern practice, including that of brass and iron.

There are 178 illustrations, both from photographs and line drawings, the latter being executed with unusual attention to vital details. Among these are many die designs ranging from those for the simplest castings to those of most intricate form. Basic principles are covered and one section is devoted to standards adopted by leading manufacturers.

The book includes practical data relating to rates of production; pressures; and alloys used for various applications—all this material having been obtained from recognized authorities in die casting practice. There is an index which enables quick reference.

□ □ □

Procedure Handbook of Arc Welding Design and Practice

Published by Lincoln Electric Co., Cleveland; available through Machine Design *for* $1.50 *plus* 15 *cents postage.*

This is the fourth edition of a very practical handbook on arc welding which is useful not only to the welder but also to designers and engineers upon whom falls the responsibility of originating or revising machines and other metal products for production by the arc welding method. An idea of the scope of the book is given by its major divisions which are in brief: Methods and equipment; technique; speeds and costs; properties of weld metal; weldability; design of welded machinery; design of welded structures; and typical applications.

Liberal use is made of illustrations, including effective line drawings showing forms of welds and design methods. In all there are nearly 1000 illustrations, of which about 300 are new. This edition includes 223 added pages.

While the book gets down to the fundametals needed by the practical welder, theory by no means is neglected. This new edition deserves a place among the reference books in the engineering department of any company which uses or contemplates using arc welding in production manufacturing, toolmaking, or in maintenance.

□ □ □

The Chemistry of Synthetic Resins

By Carleton Ellis; published by Reinhold Publishing Corp., New York; available through Machine Design *for* $19.50 *plus* 30 *cents for postage, for the set of two volumes.*

Since the first edition of this work appeared in 1923, synthetic resins and their plastics have attained utmost importance among materials of engineering—especially in the interchangeable manufacture of products produced in large quantities. To designers and engineers engaged in industries making such products—whether they be clocks or automobiles or washing machines or any of numerous other diversified lines—knowledge of plastics and their possibilities is vital.

This book goes into the subject very deeply and completely. While not recommended as light reading for the idly curious, it by no means is beyond the comprehension of the serious minded engineer or designer who really wants to know what is back of the rising tide of plastics, a rising tide which is touching new spots in industries almost every day. The inside knowledge given by Mr. Ellis—who is a well known industrial research chemist and authority on synthetic resins—will serve effectively to prepare an engineer ahead of time for that day when plastics will penetrate the field with which he is concerned. The index is unusually impressive, covering 237 pages and featuring an extensive list of trade names, makers, compositions, forms and uses of commercial synthetic resins.

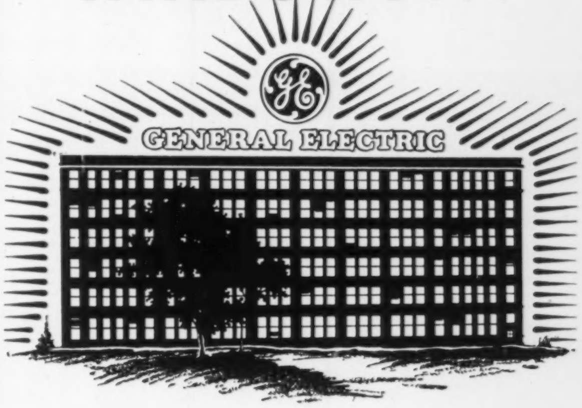
□ □ □

Control of Electric Motors

By Paisly B. Harwood; published by John Wiley & Sons Inc., New York; available through Machine Design *for* $4.50 *plus* 15 *cents postage.*

Mechanisms no longer are merely "motorized," they are "electrified." The significance of this is that incorporation of electrical drive and control has become a factor of basic design—the equipment being "built in" and not simply "built on." Therefore it behooves ma-

EVER-LIGHTED WINDOWS...



TO MAKE GOOD PRODUCTS BETTER

LIKE a beacon in the midst of a great, semi-dark industrial plant, the ever-lighted windows of the General Electric Research Laboratory shine at night—symbolic of an unending, exhaustive search for better materials, better methods, better products. And this research—begun yesterday, continued today, and planned for tomorrow—is your best guarantee of highest-quality electric equipment, regardless of the application.

In one decade alone, General Electric has spent tens of millions of dollars for research. We sincerely believe that, as a result of this immense investment, General Electric products offer you the best in electric equipment that scientifically trained minds can devise and that money can buy.

This research, in itself, is an important reason why you should choose General Electric equipment for use on your machines; but there are other reasons, too—a nation-wide acceptance of equipment bearing the G-E monogram, and unexcelled service facilities. General Electric, Schenectady, N. Y.

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A NEW MOTOR STARTER

G-E CR1061 Motor Starter

Good Looking and Easy to Wire

EVERYBODY is dressing up his products for greater sales appeal. Even the more conservative machine-tool designers are laying out their machines with an eye to pleasing appearance.

That's why we know that you, as one interested in design, will be particularly attracted to this little switch for controlling fractional-horsepower motors. Its decorative case is in keeping with the modern trend toward pleasing appearance. Besides, it's compact and easy to install, and it will live up to your standards of quality.

NOTE THESE FEATURES

Long Life at Low Cost
Rust-resisting metal parts—double-break, fine-silver contacts—totally enclosed arcing chamber for contacts.

Dependable Overload Protection
Solder-film-type overload device — switch mechanism trips free from handle on overload — can be reset on cooling.

Convenient to Install
Readily adaptable for flush mounting—switch is easily removed from case—ample space within case for wiring.

These are only a few of the reasons why you will want this switch on your machine. Bulletin GEA-2234 gives many more, and it is yours for the asking. Address General Electric Company, Schenectady, N. Y.

080-92

GENERAL ELECTRIC

chine designers to become familiar to a practical degree with recent development in electrical drive and control apparatus and with its proper installation. This book can be of very definite help to draftsmen and designers who recognize this trend toward co-ordinated mechanical-electrical engineering.

Mr. Harwood, the author, is engineering supervisor of Cutler-Hammer Inc. While he has avoided confusing theories and the higher mathematics he has not dodged important engineering facts. He comes to the point at once in the introduction when he says, "An understanding of motor characteristics is necessary to proper selection of a motor which will accomplish the desired results, and a knowledge of control apparatus is required to insure the application of a controller which will cause the motor to perform the functions required of it."

Thereafter through eighteen clearly written and well illustrated chapters, he presents a wealth of practical information on the construction, selection and application of direct and alternating current motors, contactors and relays, pilot devices, brakes, resistors and electronic devices, including a chapter on wiring diagrams.

□ □ □

Engineering Alloys—Names, Properties and Uses

By N. E. Woldman and A. J. Dornblatt; published by American Society for Metals, Cleveland; available through MACHINE DESIGN, *Cleveland, for* $10 *plus* 15 *cents postage.*

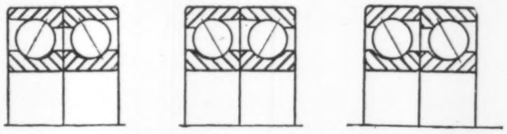
Listing 8200 proprietary commercial and technical alloys manufactured in the United States and many made in foreign countries, including England, France, Germany and Sweden, this work meets a growing demand for a practical and technical reference book on engineering alloys. This undoubtedly is one of the most comprehensive compilations ever undertaken. It involved many months of painstaking effort in the assembly, checking and rechecking of information collected from many sources. The work does justice to the standing of its authors, Mr. Woldman being metallurgical engineer of the Eclipse Aviation Corp., and Mr. Dornblatt, professor of metallurgy and chemistry in the post-graduate school of the United States Naval Academy.

The book is devoted to data on the chemical composition, physical and mechanical properties, uses and manufacturers of proprietary alloys. No attempt has been made to include alloys that conform to standard specification analyses as such. Examples of the common engineering alloys produced to customers' specifications will be found listed among proprietary alloys. However, because of their widespread usage, specification alloys of the Society of Automotive Engineers, as well as a few others of general interest, are included.

NEW *Materials and Parts*

Improves Mounting Arrangements

NEW "X" type duplex bearings, for high speed grinding spindle applications, which can be installed by the user in any one of three mounting arrangements—face-to-face, back-to-back, or tandem—have recently been introduced by Fafnir Bearing Co., New Britain, Conn. The new bearings, shown herewith, are said to provide added convenience and less possibility for error in assembling than duplex bearing units, which are matched for a single method of mounting, and must be specified on this basis in advance of purchase.



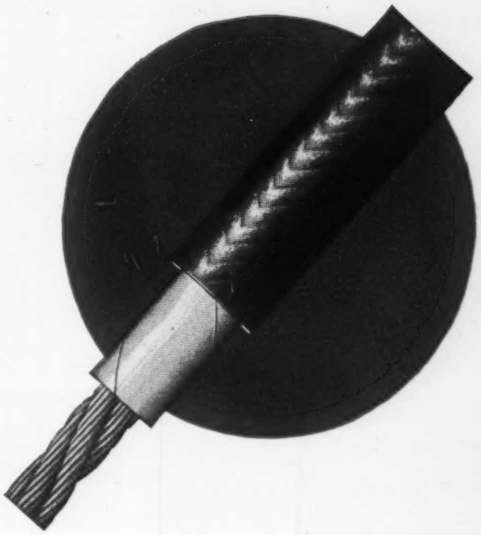
Three mounting arrangements are possible with redesigned duplex bearings

The new units, like all duplex bearings, consist of two matched single row bearings operating with the rings clamped tightly together. They are particularly applicable in providing extreme shaft rigidity for the vibrationless operating of high speed spindles where precision and finish are important considerations as well as in meeting other difficult load conditions. In contrast to single bearings of the double-row type, they are of the continuous raceway design required with extra high speeds, and are fitted with composition retainers. The bearing is available in nine sizes and capacities.

Brake Is Integral with Motor

A TOTALLY enclosed, automatic solenoid brake integral with the motor from fractional to 10 horsepower (at 3600 R.P.M.) has been brought out by Cutler-Hammer, Inc., 328 North Twelfth street, Milwaukee. This brake, shown herewith, can be supplied already mounted, on any motor, from the motor manufacturer. It is especially suitable for laundry, textile

NEED AN OILPROOF LEAD?



"YES, most assuredly," many a manufacturer has answered. Then, for your product, we wonder if this Glyptal cloth-insulated cable would fit the bill. It is oilproof — and is not affected by acids or chemicals. Moreover, it is tough, flexible, long-lived, and heat- and moisture-resisting. It *does* stand up under hard service and wears well.

We can furnish it with any kind of a finish (that shown is an asbestos-braid) for apparatus designed for 600-volt service.

This is just one of thousands of types of G-E insulated wire and cable. Perhaps our cable specialists can help you in the selection of the type that is best fitted for your product. Address nearest G-E sales office, or General Electric Company, Schenectady, New York.

520-85

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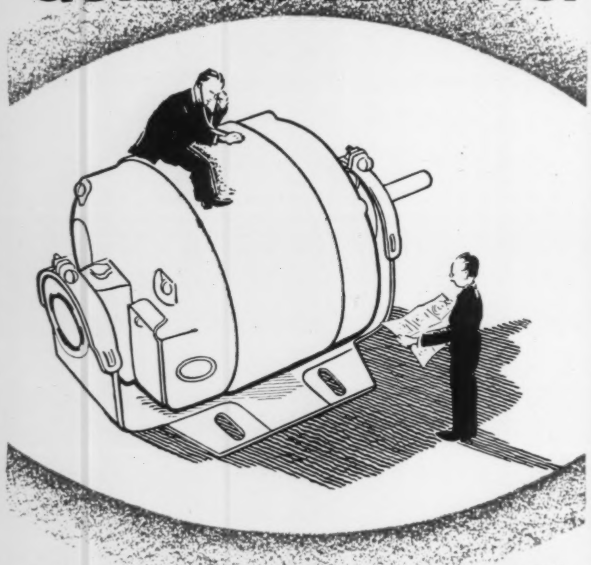
QUIET . . . COMPACT



Reasons Why You Will Like the G-E Split-phase Motor

ADD *quietness* to the sales appeal of your machines by using the resilient-base split-phase motor for constant-speed drives requiring moderate starting torques—your machines will operate more quietly and with less vibration. In addition, motor-operating costs are low because G-E split-phase motors have high efficiency and power-factor.

The G-E split-phase motor is available in many models, such as totally enclosed, dripproof, and explosion-proof, and parts can be furnished separately, if desired, for built-in applications.

General Electric also makes many other types of fractional-horsepower motors—it has a motor for every purpose. General Electric Company, Dept. 6 -201, Schenectady, New York.

Consider G-E
PERFORMANCE, CONVENIENCE, SERVICE

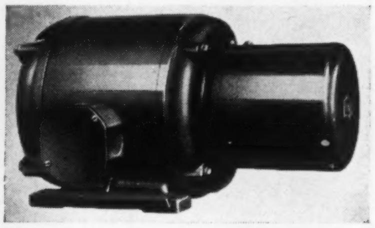
070-157

GENERAL ELECTRIC

and woodworking machinery, and for hoists, elevators, dumb-waiters, machine tools, job presses, etc.

Among its features are its appearance, which harmonizes with motor design and follows the modern trend toward self-contained and better-looking units; its dependable performance; ease of adjustment, and smooth operation. The rotating member, consisting of a single, heavy, molded disk, shows little wear on exhaustive life tests even for maximum horsepower. The enclosing case protects it from dirt and mechanical injury. This brake is suitable for alternating or direct current and is available with dust-tight, weather-proof and water-tight enclosures.

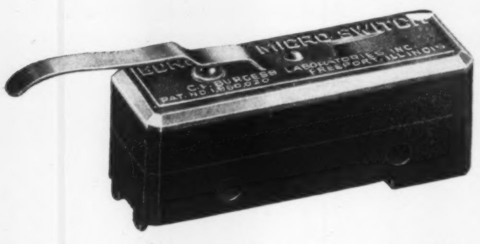
Brake is supplied already mounted on any motor to provide a complete, self-contained unit



Devices Simplify Switch Operation

RECENT improvements in the internal structure of the micro switch of C. F. Burgess Laboratories Inc., Freeport, Ill., now automatically limit the overtravel so that an unusually long life is assured at full Underwriters' ratings of 1200 watts up to 600 volts, arc. To facilitate the application of the switch to certain types of operations, two new methods of actuation have been made available. Either method may be incorporated in the standard normally closed, normally open, or double throw switch of either the self-returning or maintaining type.

One of these new methods includes a leaf spring operating lever, shown herewith, which, by providing a resilient means of actuating the switch, permits a greater movement of the actuating force than is provided by the standard plunger. Because of the lever length, the



A resilient means of actuating a switch is provided by a leaf spring operating lever operating force required is less. Use of this spring actuator avoids the necesssity for precise location of the switch. The spring can be given any shape or length desired to fit special applications.

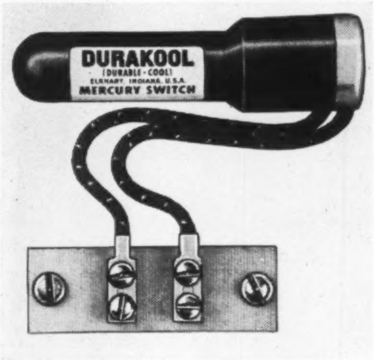
The second actuating device is a sleeve which fits over the standard operating plunger of the switch and actuates it through a spring in the cap. As this spring is less yielding than the contact arm of the switch, a differential pressure of four ounces, travelling through a distance of 0.0015-inch or less will operate the unit, just as it will without the spring mechanism. However, the spring provides an overtravel of 1/16-inch beyond the point of operation. When equipped with this mechanism, the switch can be used as a precision limit switch on machine tools which do not stop instantaneously.

MICRO SWITCH
LABORATORIES, INC.
FREEPORT, ILLINOIS

When equipped with a sleeve over the operating plunger, this control can be used as a precision limit switch

Mercury Switches Are All Metal

FOLLOWING the radio tube trend toward all metal construction comes a new metal mercury switch for use in automatic electrically controlled devices as built by Durakool Inc., 1008 North Main street, Elkhart, Ind. In place of the conventional glass envelope used in mercury switches, a metallic envelope is employed, thus preventing breakages. The switch shown herewith, will continue to operate though the envelope be dented or bashed in. Instead of the usual dry hydrogen gas used in conventional types of mercury switches, this



Mercury switch opens and closes at exactly specified angles which are independent of the load

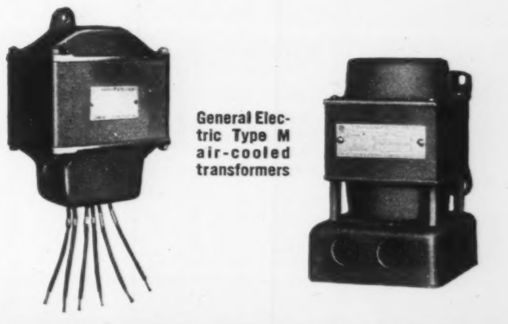
WHEN YOU NEED LOW VOLTAGE FOR YOUR MACHINE—

G-E AIR-COOLED transformers are just the thing. They give the correct voltage at the point of use, and can be designed with correct characteristics for special conditions.

One manufacturer, for example, is using a G-E air-cooled transformer to supply power to his home-workshop welder. The small, compact size of the transformer permitted the design of a light-weight portable welder capable of welding up to 20-gauge steel.

Likewise, the Standard Oil Company of Indiana wanted a 32-volt source of supply for portable lamps and tools, to afford greater safety to workmen. G-E small air-cooled transformers economically reduced the supply voltage to the desired value.

In addition to solving your problems of built-in power supply, these transformers will solve your low-voltage lighting problems. Try them for yourself—if it is low voltage you want, you'll find these G-E transformers are the answer. General Electric, Schenectady, N. Y.



General Electric Type M air-cooled transformers

320-84

GENERAL ELECTRIC

Reduces Shaft Friction

The tapered edge of the leather washer of the Gits Precision Oil Seal reduces shaft friction. Only the slightest pressure at this point forms an effective oil seal.

Precision Oil Seals are just that . . . they are accurately machined to very close tolerances. They are equally efficient on horizontal or vertical shafts.

A Folder Will Be Mailed at Your Request.

GITS BROS. MFG. CO.
1861 So. Kilbourn Ave., Chicago, Ill.

GITS Precision Oil Seal

Specify **MOTORPUMPS** *—for Economy*

—compact
—self-contained
—save expensive power take-off

3 sizes of Geared Motorpumps—Nos. 101-102-103
2 sizes of Centrifugal Motorpumps—Nos. 204-210
May we send data, performance, etc.?

Brown & Sharp
Mfg. Co.
Providence, R.I.

BROWN & SHARPE PUMPS

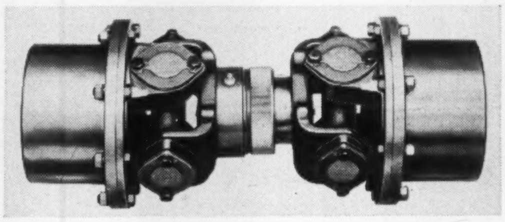
B·S

new switch uses a liquid fill that eliminates the usual hydrogen gas leakage or absorption. This viscous liquid fill forms a stabilizing film. False contacts and unexpected breaks are eliminated.

The metallic envelope is encased in a molded bakelite insulator. Electrical clearances are such that when installed in wet places no leakage or flash-over occurs. This new mercury switch differs in operation from conventional types in that it opens and closes at exactly specified angles, these angles not only remaining the same throughout the life of the unit, but are independent of load. The switch has a resilient sealing means that is not affected by sustained overloads and mechanical shock.

Shafts Overcome Angular Misalignment

COMPLETE flexibility as to the alignment of driving and driven shafts in a machine, their angular relationship and possible changes in spacing between them during operation is permitted by the unique Watson-Spicer connecting shaft introduced by H. S. Watson Co., 525 Fourth street, San Francisco or P. O. Box 385, Toledo, O. This needle bearing shaft, shown herewith, is of simple metal-to-metal construction. Needle bearing universal joints at each end provide flexibility; tubular connecting shaft carries the torque load; and a splined slip connection accommodates endwise movement. Each joint will absorb fixed or variable angular misalignment up to a maximum of 20 degrees each side of center line. Endwise variations of an inch or more can be accommodated. The shaft is made in all lengths from a few inches to several feet, in a variety of types and sizes, with capacity from 1 to 250 horsepower.



Flexible drive shaft has needle bearing universal joints at each end

Sheets Insure Bond With Paint

FULL commercial production of a new kind of galvanized sheet that assures a good paint bond on iron and steel surfaces has been announced by Amer-

The
ARISTOCRAT
of Bearings

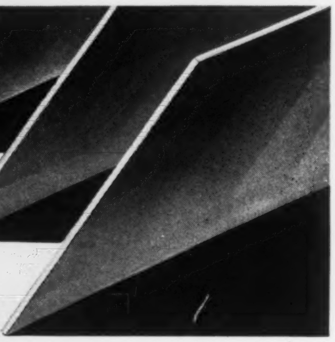
HOOVER
HOOVER
HOOVER

FIRST CHOICE
OF
AMERICA'S LEADING MACHINE BUILDERS

HOOVER
BALL *and* BEARING CO.

ANN ARBOR . . . MICHIGAN

Extra
WIDE
FLATS



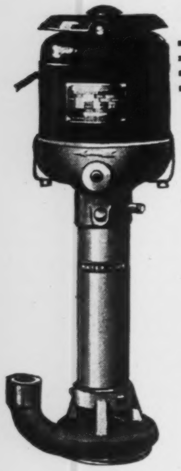
Convenient Steel Sections, *cold drawn* to true flatness and straightness with close size tolerances. Widths up to 12" and thickness from 1/4" to 2"—*cold sawed* to length. Well adapted for bed plates and similar machine parts where accuracy contributes to economy and good workmanship. Your inquiries are invited.

Cold Drawn Bars
Shafting -:- Special Sections
Ultra-Cut Screw Stock
Alloy Steels

BETTER MADE STEELS
LABORATORY TESTED

BLISS & LAUGHLIN, INC.

HARVEY, ILL. *Sales Offices in all Principal Cities* **BUFFALO, N.Y.**



OPEN TYPE

DESIGNED TO WITHSTAND

the destructive action of lapping compound when attached to grinding machines.

THE **BROWNIE Coolant Pump**

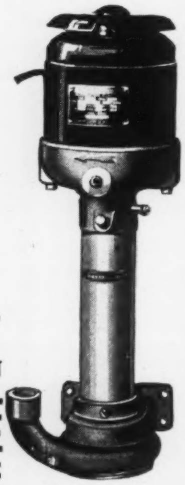
proves itself economically suited to any machine design.

Centrifugal in operation — the Brownie Pump is self aligning. Full rigidity of driving shaft is assured by the vital support of a ball bearing within one inch of the impeller.

Both drive shaft and impeller tube are one unit revolving together. There are no packings to leak and no screens to clog. Capacities 10-100 G.P.M.

TOMKINS-JOHNSON CO.
618 N. MECHANIC ST.
JACKSON MICHIGAN

CLOSED TYPE



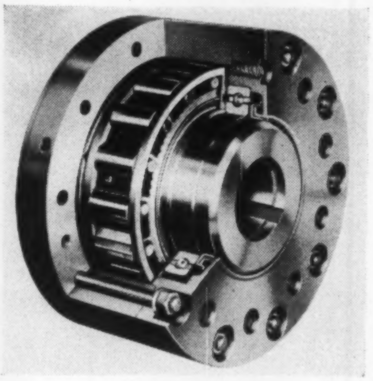
ican Rolling Mill Co., Middletown, O. This new kind of galvanized sheet metal can be painted without special treatment of the surface by the user. Paintgr sheets, the manufacturers say, are chemically treated to produce a finely crystalline phosphate coating which in itself is neutral to paint (being neither acid nor alkaline) and keeps the paint from direct contact with the zinc surface. This coating is an integral part of the sheet and is slightly granular in nature.

The sheets are available in any of the grades of galvanized sheets manufactured by the company. Analysis of the base metal can be that of Armco Ingot Iron, plain or copper-bearing steel. When it is required, all grades of these sheets can be supplied stretcher leveled.

Forming qualities of the sheets are the same as untreated galvanized sheets. They may be soldered satisfactorily with the use of hydrochloric acid as a flux. So-called "cut-acid" is not strong enough to penetrate the Paintgrip film, which must be dissolved before a good solder bond can be obtained.

Clutch Relieves Shaft Loads

EXCEEDINGLY low but constant resistance to free-wheeling, regardless of whether the driving or driven element does the free-wheeling, is provided by the new one way clutch of Morse Chain Co., Detroit. This is accomplished by a series of individually sprung cams actuated by the main drive gear and restrained from the action of centrifugal forces by retainer rings supporting each end of the cams. This design, shown herewith, permits the use of a large number of cams which offers the maximum in capacity at a given diameter of clutch and provides smooth and immediate engagement at synchronization of speeds between driving and driven members.

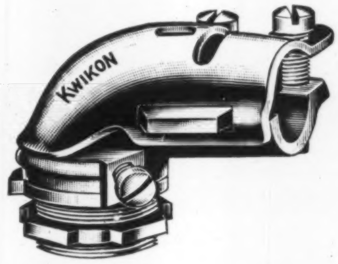


One-way clutch offers very low but constant resistance to free-wheeling regardless of whether driving or driven unit does the free-wheeling

The uses of this clutch extend from the ratchet feed mechanisms of a small printing press to the clutch connection between huge turbines, gas or electric motors and the units driven by these sources of power. Several sizes are available adapted to ¼-horsepower per hundred RPM to 100-horsepower per 100 RPM and provided with flexible couplings in either the Morflex rubber insert type or the chain coupling when required. The function of the clutch is to relieve driving or driven shaft loads where intermittent or standby service is needed.

Simple Adjustments Are Assured

ADJUSTMENTS of the angle of cables from outside the machine to which they are attached are enabled by the new swivel device developed by Kwikon Co., 610 West Jackson boulevard, Chicago. This connector permits tightening or adjusting of the angle without disturbing any other part of the machine. The body of the unit, shown herewith, rotates on a swivel, the threaded shank remaining rigid. The desired angle is set by means of a setscrew, outside the machine, which takes the strain which otherwise would be on the locknut inside. This prevents the locknut from loosening. The setscrew is readily accessible.



Swivel device permits the adjustment of the angle of cables from outside of the machine

Introduces Two New Compensated Belts

TWO new styles of Condor compensated belt, known as style "F" and "B," have been developed by the Manhattan Rubber Mfg. division of Raybestos-Manhattan, Inc., Passaic, N. J. Both have the patented compensated principle of equalized ply stresses at the arc of contact, but are especially designed for those unusual conditions which require some slip rather than an extremely high coefficient of friction for low-tension operation.

Style "F" has a red friction pulley surface and is designed for use where a slight starting slip is desired, while style "B" has a bareback untreated duck pulley surface and is built for conditions calling for a greater slip, or where slip is essential, as in the case

BALDOR BUILDS *Better Motors*

BALDOR PERFORMANCE *is the result of*

17 YEARS OF SPECIALIZED EXPERIENCE

Baldor's success has been built upon the manufacture of but *one* product—Electric Motors. Obviously they had to be RIGHT.

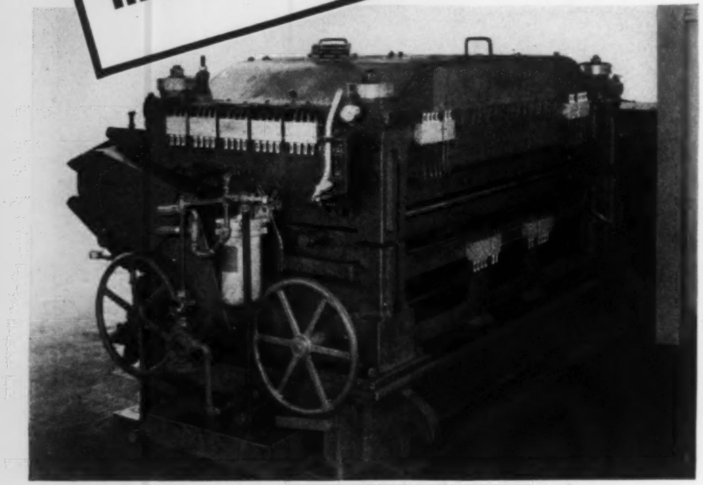
From the start, we builded substantially and specialized in the manufacture of the finer motors . . . and after 17 years we are still sticking to the policy of Quality and Guaranteed Performance. We will never lower our standard.

BALDOR
ELECTRIC
COMPANY

4300
DUNCAN AVE.
ST. LOUIS, MO.

BALDOR
A BETTER MOTOR

Even the
best lubricant
must be properly applied



Farval on "Aetna-Standard" Sheet Processing Machine

THE best lubricant in the world cannot help your customer—the user of the machine you design—unless you provide reliable means of applying it systematically and regularly to every bearing.

Farval Centralized Systems provide adequate lubrication and protection at every point; quickly pay for themselves through reduced labor of oiling and waste of oil; reduced power consumption and increased bearing life. They increase production by reducing outage time; and also prolong life of equipment.

The Farval Centralized System of Lubrication is a mechanical method of delivering clean lubricant from a central station under high pressure to a group of bearings, in exact, measured quantities. Operation is constant and positive, regardless of the number of bearings in the system, and not a bearing is missed.

Design Engineers are invited to write for complete information and technical data. The Farval Corporation, 3265 E. 80th St., Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing.

FARVAL
CENTRALIZED SYSTEM OF LUBRICATION
Special Delivery to Every Bearing

of winder drives.

There are no differences between the construction of these belts and that of the regular Condor low-tension belt except for the pulley surface. The principle of equalized ply stresses consists of building the belt to conform to the pulley curvature thereby relieving the excessive stresses thrown on the outer plies.

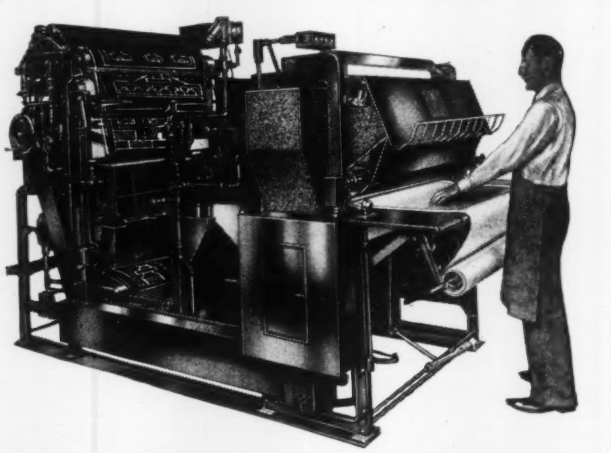
Metal Vanes Increase Heating Area

METAL vanes, each welded to the flat tubular sheath of the unit, assure a high rate of conduction of heat from the unit to the vanes and consequently rapid convection of heat from the vanes in the electric air-heating units of Harold E. Trent Co., 620 North Fifty-fourth street, Philadelphia. The size of the vanes in the units, used in conjunction with free or compressed air, varies with the type and size of the enclosure and the medium for facilitating convection. They are available in eight standard lengths with variation of wattage and voltage to suit users' requirements. The heating unit casings are, for most purposes, made of steel, but alloys of steel or copper can be supplied to meet particular needs. Various terminal arrangements are available.

Engineering Department Equipment

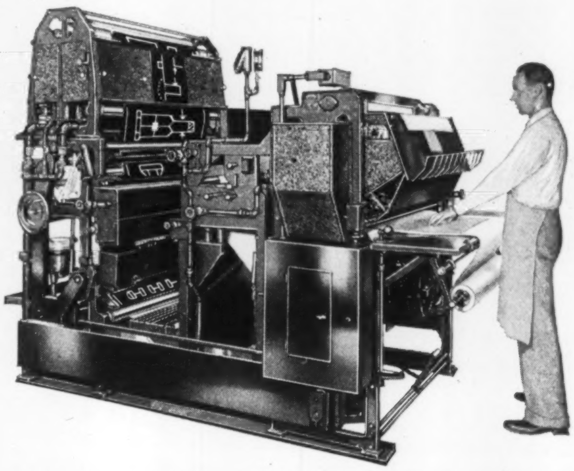
Improved Blueprinters Are Developed

TWO new blueprinting machines, model "27" with radiator type dryer and model "27-D" with double drum type dryer, have been announced by C. F. Pease Co., 819 North Franklin street, Chicago. Either the



Lamps in blueprinter feature an entirely new electrical circuit and a balanced mechanism blueprinting machine separately or in combination with the washing, developing and drying equipment is available in two sizes to accommodate all widths of sensitized paper or cloth up to either 42 or 54 inches wide for reproduction work in cut sheet sizes or in continuous operation. When it is desired to operate the model "27" blueprinter separately or in conjunction with either the model "27" or model "27-D" washing and drying units this can be accomplished by means of a simple clutch adjustment for either condition.

Tracings and paper are fed in together at the front of the machines where they travel upward and around a curved segment of highly polished "Trans-Peco" glass where exposure is accomplished by means of a series of high power "Actinic" enclosed arc lamps. These lamps feature an entirely new electrical circuit and a friction-free, balanced mechanism and are so mounted in relation to the contact glass that all the total effective printing rays of the lamps are utilized.



Washing, developing and drying equipment can be used in combination with new blueprinters

After exposure, when running cut sheet sizes, prints and tracings are both returned into the tray at the front of the machine for separate hand washing, developing, and drying—but when operating continuously tracings only are returned to the front of the machine while the prints on the continuous roll of paper travel over into the first horizontal water wash where they are permanently fixed and cleansed of all "unreduced" sensitizing solution. Following this they travel downward into the machine and over and around a revolving rubber covered coating roll where they are thoroughly developed by means of a uniform application of developing solution varying according to the character of prints being run. After developing, the prints on the continuous roll of paper are carried upward into a forceful and final spray-jet water wash where they are thoroughly cleansed of any surplus developing solution.

DESIGN

ON PARADE

Through the centuries design has moved forward. Often hated, frequently fought, design progress could not be stopped.

Today the tempo has quickened. The parade doesn't wait for laggards!

This parade is pictured in the pages of *Machine Design*. Every article is a record of progress from which the design engineer can adapt ideas to his own problems.

From the more than 6200 manufacturers of machines, from the thousands of makers of parts, materials and process equipment, from practicing engineers and the laboratory, the latest developments are brought to your attention.

Short, pertinent design topics are covered each month under the heading "Scanning the Field for Ideas."

Watch for these developments!

MEETINGS *and* EXPOSITIONS

Jan. 7-11—

American Engineering council. Annual meeting to be held in Washington. F. M. Feiker, 744 Jackson Place, N.W., Washington, is secretary.

Jan. 11-14—

National Association of Coin Operated Machine Manufacturers. Coin machine show to be held at Hotel Sherman, Chicago. Information regarding the show may be obtained from the association at 120 South La Salle street, Chicago.

Jan. 11-15—

Society of Automotive Engineers. Annual meeting to be held at Book-Cadillac hotel, Detroit. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Jan. 11-16—

American Road Builders association. Annual meeting and exhibition of machinery to be held at New Orleans. Charles M. Upham, 952 National Press building, Washington, is secretary.

Jan. 25-27—

American Society of Heating and Ventilating Engineers. Annual meeting to be held at Hotel Statler, St. Louis. A. V. Hutchinson, 51 Madison avenue, New York, is secretary.

Jan. 25-29—

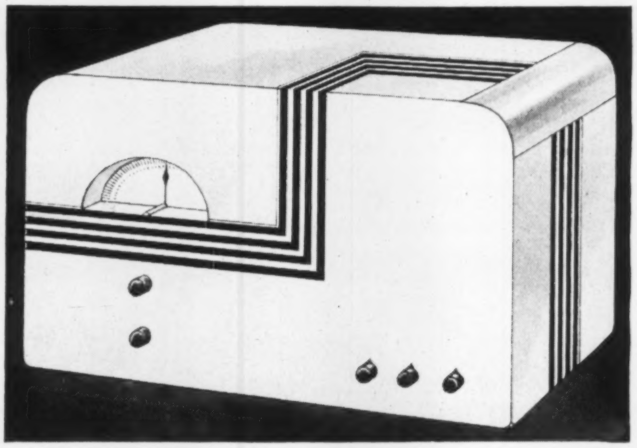
American Institute of Electrical Engineers. Annual winter convention to be held at Engineering Societies building, New York. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary.

Feb. 14-19—

National Electrical Manufacturers association. Midwinter meeting to be held at Waldorf-Astoria hotel, New York. W. J. Donald, 155 East Forty-fourth street, New York, is managing director.

Feb. 22-25—

Technical Association of the Pulp and Paper Industry. Annual meeting to be held at Waldorf-Astoria hotel, New York. R. G. MacDonald, 122 East Forty-second street, New York, is secretary.



DESIGNING
for 1945

INSUROK *Laminated or Molded*

RICHARDSON TECHNICAL SERVICE
. . . is at your command, without cost or obligation, to assist in the application of INSUROK to production equipment as well as to the finished product.

To give permanence to the genius of the designer, the skill of the craftsman, to insure uninterrupted production schedules, INSUROK, the superior laminated or molded plastic, is being more widely used in machine design than ever before. Because of its known physical, chemical and dielectric characteristics . . . resistance against abrasion, neglect, abuse, water, oils and other liquids, adaptability for use in gears, pinions, bearings and numerous machine parts, INSUROK offers unlimited opportunities for the improvement of practically all mechanical equipment. Details and copy of INSUROK Handbook on request.

The RICHARDSON COMPANY
Melrose Park, (Chicago) Ill. Founded 1858 Lockland, (Cincinnati) Ohio
New Brunswick, N. J. Indianapolis, Ind.
Detroit Office: 4-252 G. M. Building, Phone Madison 9386
New York Office: 75 West Street, Phone Whitehall 4-4487

Quiet Machinery Often Costs Less

(Concluded from Page 43)

he is interested. Practically, such an attack would be far beyond the realms of economic possibility in both time and cost. The chances are that the machinery would be worn out before the measurements could be completed. The only feasible method is to modify the attack and the technique of measurement to solve the problem at hand with a minimum of experimentation.

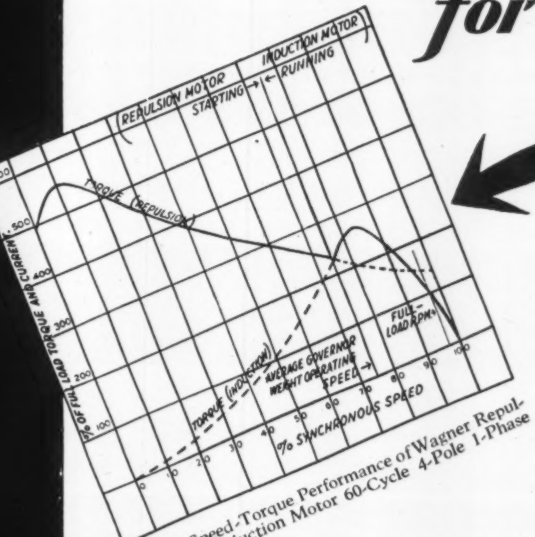
Sound-level (total noise) measurements were sufficient in some of the problems. In others such measurements formed an important part of the data but were not sufficient. In others they were of no use at all. Frequency analysis is an extremely powerful tool by which many problems can be solved. These measurements are particularly valuable if one is interested in components of a sound which consists of musical notes which are reasonably constant in frequency. Such notes are often encountered, but most machinery noises include more or less unpitched sound. In many cases the unpitched sound forms the most prominent or objectionable parts of the noise. Frequency analysis is not particularly useful for dealing with this type of sound. Some sort of band analysis or special frequency weighting is required. Often the sounds are not constant with time, and some means must be devised to measure the time changes.

Should Correlate Related Factors

Acoustical measurements are most valuable when they are correlated with other knowledge of the machine; changes in its parts, measurements of the internal action, or peculiarities in the method of manufacture. As indicated, such correlations almost invariably yield unexpected information which leads to solutions of problems which might never be imagined otherwise.

In many cases it costs no more to build quiet machinery than it does to build noisy machinery. In fact, as shown in this paper, a decrease in production cost often accompanies a job of quieting. Obviously, such desirable results are not obtained by tacking some sort of an acoustical treatment on an otherwise noisy machine; the quietness must be built into it. The possible methods of quieting a machine are often many, and it is a question of determining the best way to obtain a given reduction. Acoustical measurements provide an affective and direct means of doing this work and lead to solutions which are practically impossible by ordinary methods.

Good MOTOR PERFORMANCE is Essential For Satisfactory Operation



Typical Speed-Torque Performance of Wagner Repulsion-Start-Induction Motor 60-Cycle 4-Pole 1-Phase

Examine the performance curves of WAGNER MOTORS and see why they will give satisfactory service on your job.

On examination of the typical speed-torque curves of a Wagner repulsion-start-induction type "A" motor shown at the left, you will see why these motors will stand up under heavy load conditions. These curves represent approximately the average performance of Wagner repulsion-start-induction motors. By following the solid line it will be noted that the starting torque exceeds five times full-load torque and at approximately 82% full-load speed the torque is 2½ times full-load torque. These high-torque characteristics of Wagner repulsion-start-induction motors make them particularly desirable for machinery with severe starting and running requirements.

Performance is but one of the important qualities to consider in the selection of motors. Such factors as dependability, quietness, interchangeability, and careful design are equally important requisites. These considerations and all the other details you may want to know about Wagner small motors are completely described in Wagner Small Motor Bulletin 177. Write for this bulletin.

MS 336-3J

Wagner Electric Corporation
6400 Plymouth Avenue, Saint Louis, U.S.A.

MOTORS • TRANSFORMERS • FANS • BRAKES

MANUFACTURERS' PUBLICATIONS

ALLOYS (STEEL)—Information to aid in the proper selection of steels for carburized parts is given in a pamphlet recently prepared by Union Drawn Steel Co., Massillon, O. Suitability of various steels of the company are discussed.

BEARINGS—Characteristics of graphite bronze bearings and bushings and sheave bearings are completely given in a new catalog of Randall Graphite Products Corp., 611 West Lake street, Chicago. For quick reference, this catalog has a thumb index of all standard sizes of bearings.

CONTROLS (ELECTRICAL)—Major features in the design of Con-Tac-Tor mercury switches are given in a bulletin published by Brown Instrument Co., Wayne and Roberts avenues, Philadelphia. Mercury switch circuits are made and broken in gas-tight glass chambers, eliminating hazards of open contacts in the operation of equipment subject to inflammable or explosive atmospheres.

CONTROLS (ELECTRICAL)—General information on mercury switches is given in two new catalogs published by Durakool Inc., 1010 North Main street, Elkhart, Ind. "Mercury Switches" presents photographs and tables on various switches, while the second, "Durakool Mercury Switches," discusses in detail the characteristics of the switches.

DRIVES—Variable speed transmission is covered in the new catalog of Lenney Machine & Mfg. Co., Warren, O. This describes the principle of operation, speed regulation, speed control and various other features of this unit. Drawings and illustrations are included.

DRIVES—Power transmission equipment is fully described and illustrated in Catalog No. 51, issued by Boston Gear Works, North Quincy, Mass. Numerous tables listing various specifications, characteristics, sizes and types available of gears, speed reducers, ratiomotors, chain drives and ball bearings are given.

DRIVES—Bulletin No. 302, prepared by Graham Transmissions, Springfield, Vt., discusses in detail the types and applications of transmissions and also includes various tables on principal dimensions of both built-in motor and coupled-motor types of transmissions, and their speeds and capacity. Speeds are adjusted by varying the position of a contact ring along rotating tapered rollers.

DRIVES—The subject of variable speed control is dis-

WHETHER YOU DESIGN FOR WELDING, BUILD BY WELDING, OR USE WELDING IN ANY WAY **YOU NEED THIS BOOK**

Procedure Handbook of Arc Welding Design and Practice
819 Pages—990 Illustrations

Architects, engineers, designers, builders, fabricators, erectors, foremen, supervisors, production managers, estimators, maintenance men, welding operators—everyone using welding—needs the big, new, complete Handbook.

Long recognized throughout the world as the authority on the art of electric welding. Used by engineering, technical and vocational schools . . . colleges and universities. Standard welding reference guide in thousands of industrial plants in U. S. A. and foreign countries. New Handbook makes all others obsolete. Contains complete, authentic, up-to-date data on all latest arc welding applications and design procedure.

FOURTH EDITION GIVES YOU, AT NO INCREASE IN COST,
223 pages of new welding data • 289 new illustrations

Note scope of Handbook's contents in 8 principal parts:

I—Welding Methods and Equipment. 19 Pages, 6 Illustrations.
II—Technique of Welding. 71 Pages, 93 Illustrations.
III—Procedures, Speeds and Costs for Welding Mild Steel. 76 Pages, 83 Illustrations.
IV—Structures and Properties of Weld Metals. 13 Pages, 19 Illustrations.
V—Weldability of Metals. 72 Pages, 30 Illustrations.
VI—Designing for Arc Welded Steel Construction of Machinery. 146 Pages, 190 Illustrations.
VII—Designing for Arc Welded Structures. 165 Pages, 216 Illustrations.
VIII—Typical Applications of Arc Welding in Manufacturing, Construction and Maintenance. 201 Pages, 353 Illustrations.

Written in clear, concise style. Answers all questions about arc welding. Stops guesswork . . . prevents costly errors . . . assures greatest profits from most efficient welding. Will pay for itself over and over again. Only complete book of its kind available. A veritable gold mine of pertinent data and a wise investment.

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cussed in an unusual booklet entitled "Speed Control at Work" published by Reeves Pulley Co., Columbus, Ind. It includes a complete description and illustration of the methods employed by twelve nationally known manufacturers in securing speed adjustability of production machines. The company's speed control equipment is also featured in this booklet.

FASTENINGS—"Bristo Screw Products," known as Bulletin No. 833, has recently been issued by Bristol Co., Waterbury, Conn. It contains information on socket head stripper bolts, pipe plugs, wrenches, multiple spline sockets, and set and cap screws.

LUBRICATION AND LUBRICATING EQUIPMENT—Gits Bros. Mfg. Co., 1861 South Kilbourn avenue, Chicago, has issued a catalog, No. O.S. 36, on Tru-Circle, precision, high speed, and felt, oil and grease seals. Descriptions and illustrations of the various types manufactured by the company, as well as mounting instructions and applications are given.

MOTORS—The new and improved design of type SK DC motors is described in a leaflet, recently issued by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The motors, designed to withstand internal explosion, range in sizes from 5 to 75 horsepower, and 115, 230 and 550 volts.

PACKING GLANDS AND PACKING—A materials sample circular is being distributed by Felt Products Mfg. Co., 1506 Carroll avenue, Chicago. This circular contains samples of various types of felt, cork, rubber, leather, and paper and asbestos materials, as well as giving an outline of the uses for which each material is best adapted.

PLASTICS—Richardson Co., Cincinnati, has just published a handbook describing the plastic, Insurok. The handbook discusses qualities, uses and machinability, as well as listing the specifications of the various grades of Insurok available.

PNEUMATIC EQUIPMENT—C. A. Norgren Co. Inc., Denver, Colo., recently published a catalog, No. 200, covering its complete line of pneumatic products. It includes characteristics, illustrations and sizes available of the sight feed automatic air line lubricator and other automatic lubricators, regulating and reducing valves, various types of regulators, and water, steam, air, gas and oil strainers.

PNEUMATIC EQUIPMENT—The new catalog, No. 224, of Hanna Engineering Works, 1765 Elston avenue, Chicago, enables the designer or chief engineer to determine if a cylinder of a given diameter and length of stroke can be incorporated in his plans, as the catalog contains dimensions, capacities and illustrations of numerous types of cylinders to meet various installations, particularly mounting requirements.

PUMPS—Roots-Connersville Blower Corp., Conners-

When you're designing Equipment that must be made on Production Basis —be sure to specify—

UNBRAKO

KNURLED-SOCKET HEAD CAP SCREWS

They cut Assembly Costs

Just ask any mechanic—he'll tell you he uses his fingers as much as possible when driving screws. "Unbrako" knurled heads give him a better grip so naturally he can turn them faster and farther before he has to apply a wrench.

Furthermore "Unbrakos" are the only Hollow Head Cap Screw that can be locked. There are two simple ways of doing this—they're explained in Bulletin 485—you should have a copy.

STANDARD PRESSED STEEL Co.

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DETROIT

JENKINTOWN, PENNA.
Box 102

BRANCHES
INDIANAPOLIS
SAN FRANCISCO
ST. LOUIS

ville, Ind., has prepared a bulletin, No. 260-B11B, descriptive of its line of type "T" turbine pumps. Various illustrations of driving arrangements are presented, as well as selection tables of pumps for capacities from 5 to 200 gallons per minute.

WELDED PARTS AND WELDING EQUIPMENT—Lincoln Electric Co., Cleveland, has issued a bulletin covering the new "Shield-Arc S.A.E." welder which enables the operator to get any type of arc at each and every value of welding current.

WELDED PARTS AND EQUIPMENT—The booklet, "Airco Acetylene," prepared by Air Reduction Sales Co., New York, presents the story of acetylene for welding and cutting and its heating efficiency.

WELDED PARTS AND EQUIPMENT—Practical lessons in arc welding are given in the book entitled "The New Arc Welding Manual and Operator's Training Course," published by Hobart Bros., Troy, O., which covers the welding arc, welding equipment, weldability of metals, types of joints and welds, strength of welds, speed and cost of welding, use of the metallic arc, welding with bare electrodes and welding with coated electrodes. Copies will be sent free of charge to engineers applying on company letterhead.

ZINC—A profusely illustrated booklet entitled, "Supplement to A Visual Report of Progress," represents the progress made in the die casting industry since the publication of the original "A Visual Report of Progress" last year, by New Jersey Zinc Co., 160 Front street, New York. Another booklet of the company, "Zinc Metals and Alloys" briefly gives information concerning all of the company's metal products except rolled zinc. A section is devoted to Zamak alloys for die castings, including figures on physical properties, dimensional stability, corrosion resistance and A.S.T.M. specifications.

Research Publications

The Measurement of Attitude and Eccentricity in Complete Clearance Bearings, by D. Clayton and C. Jakeman. In this investigation measurements were made on complete clearance bearings 2 inches in diameter and 2¼ inches long, lubricated with a heavy mineral oil, the journal being of steel and the bush of hard bronze, under varying loads and speeds and with varying diametral clearances. The attitude-eccentricity locus was found for each load, speed and clearance as the temperature was raised from room temperatures until incipient seizure occurred. The eccentricity varies directly as the load and clearance and inversely as the speed and viscosity; the form of the locus changes progressively with the clearance. The friction on the bush was measured, and the friction on the journal was deduced, using the measured horizontal displacement. The coefficient of friction has been plotted against eccentricity and both have been plotted against nondimensional groups of the variables. Published by Institution of Mechanical Engineers, London. 54 pp.

THE SOLID SHIM THAT P-E-E-L-S FOR ADJUSTMENT

LAMINUM
Precision adjustment SHIMS

anti-friction bearings

LAMINUM SHIMS are an invaluable "first aid" on anti-friction bearing applications. Precision adjustments of .002" or more at a time are made by simply P-E-E-L-I-N-G the laminated shim! No filing . . . no machining. The same saving of precision machining in factory assembly is repeated for the user every time re-assemblies are made!

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Cleveland Detroit Milwaukee
692

WHEREVER AIR IS NEEDED

Specify "R-C" pumps

With many an experienced machine designer, it has become almost routine procedure to call on "R-C" whenever he has an operation that calls for a blower or vacuum pump. The experience of "R-C" engineers in designing blowers for special applications, coupled with the availability of a wide range of standard "R-C" Blowers suitable for many applications, greatly simplify the problem of securing the right blower for your purpose.

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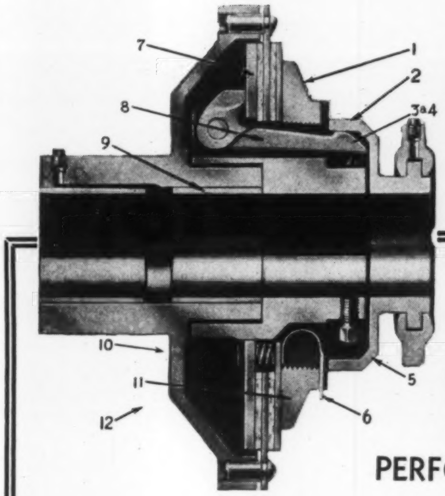
CONNERSVILLE
BLOWER CORP.
CONNERSVILLE, INDIANA



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SINCE 1904, The Conway Clutch Company has held tenaciously to certain salient features in Clutch design. Points of construction that provide the notable characteristics of Conway Clutch functioning are:

Easy Engagement,	One-Point, Independent Adjustment,
Instant Release,	
Drag-Free Idling,	Power Capacity,
Interchangeable Parts,	Centripetal Action.

In 1936, as in 1904, the Conway Clutch is in the lead.

Catalog P-20, fully illustrative of these twelve features, will be mailed to any designing engineer or interested party upon request.

Bulletin L28 on Large Size Disc Clutches is ready.

THE CONWAY CLUTCH CO.

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Cincinnati, Ohio

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FOOTE GEAR WORKS
CICERO, ILLINOIS
SIZE 4143 MV

Motorized vertical helical reducer 4143-MV

FOOTE GEAR WORKS
OIL LEVEL

Motorized double worm gear variable speed reducer 7-20-D

the above are among the many installations made by the Foote Gear Works Inc., and now doing service satisfactorily in plants throughout the country.

The vertical helical is one of 32 units installed to drive agitators in 126 foot diameter digester tank ½ H.P. motor—1200 RPM—ratio 80½ to 1. Installation made in southwest sewage disposal plant, Chicago Sanitary District.

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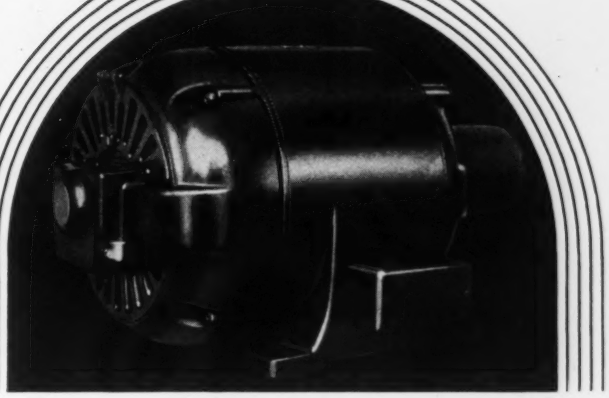

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both Strength
and Silence!

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SILENT
STEEL *Gears*

No other gear gives *all* their advantages!

The laminated construction eliminates noise.

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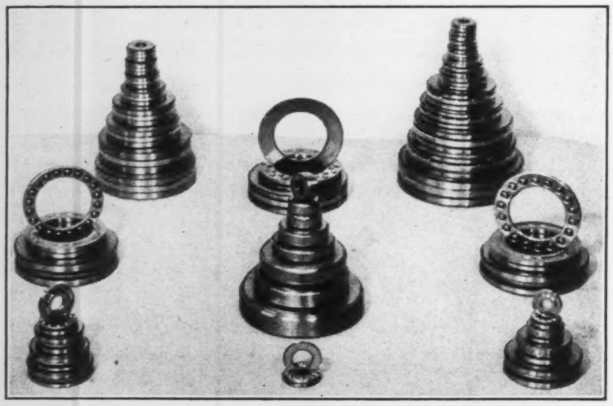

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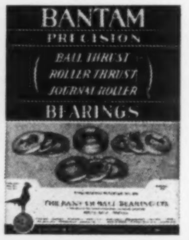
The sincere interest of our organization in the successful operation of its customers mechanical developments is what has caused industry to more and more prefer Bantam Ball and Roller Bearings.

Of course, this interest had to be backed up by the ability to solve the bearing problem and in many cases do what others had not been able to accomplish. That, for instance, is why 95% of the automobiles built use Bantam Roller Bearings. Also why practically all Diesel Motors use them.



Every designing engineer in the country should have a copy of our new catalog. It shows a comprehensive picture of the bearings which are saving money for manufacturers of small and large machinery. Send TODAY!

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SOUTH BEND, IND.

BBB TAKE YOUR TOUGHEST BEARING JOB TO BANTAM

Business and Sales Briefs . . . .

OFFICES of Shafer Bearing Corp. have been moved to Pure Oil building, 35 East Wacker Drive, Chicago. A district sales office is also being opened at 545 West Washington boulevard, Chicago, carrying a display of roller bearings and mounted bearing units for industrial power transmission and other applications. Complete stock will also be maintained at this office for immediate delivery in the Chicago territory.

* * *

H. W. Schmid will represent the Ohio Electric Mfg. Co., Cleveland, for the sale of motors in the Indianapolis territory, with offices at 1955 Ruckle street, Indianapolis.

* * *

Stearns Magnetic Mfg. Co., Milwaukee, has opened a sales office at 369 Architects building, Philadelphia, with James Whiting in charge.

* * *

George P. Dempler Co., 3318 Latonia avenue, Pittsburgh, has been appointed representative in the Pittsburgh district by Chapman Transmission Corp., Buffalo, N. Y., successors of Transmission Ball Bearing Co.

* * *

The branch office and warehouse of Columbia Tool Steel Co., Chicago, located at 169 South Second street, Milwaukee, will be moved about Dec. 15 to 441 North Sixth street, Milwaukee. Carl F. Scheid is district sales manager at Milwaukee.

* * *

At the meeting of the directors of the Gray Iron Founders' society, Nov. 10, a special membership with fixed dues was created for manufacturers' foundries so that the entire industry might be represented instead of jobbing foundries only.

* * *

Pheoll Mfg. Co., 5700 Roosevelt road, Chicago, is constructing a two-story addition to the present factory building. The new structure is to be occupied by the general offices, the remainder being used for finished products and the packing and shipping departments.

* * *

William J. Jockers has been made assistant sales manager of Diehl Mfg. Co., Elizabeth, N. J. Mr. Jockers is widely known in the manufacturing and jobbing divisions of the electrical industry, having been affiliated for more than 26 years with the Westinghouse Electric & Mfg. Co. and Westinghouse Electric Supply Co.

* * *

Dow Chemical Co., Midland, Mich., has announced the opening of a Chicago office, located in the Field building, 135 South La Salle street. According to Willard Dow, president of the company, the opening of this office was due to increasing business. Wilson I. Doan will be in

a HANDY GUIDE..

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A thoroughly proven, efficient pump for power transmission.

Capacities—
0 to 2000
0 to 4000
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cu. in. per min.

The variable volume feature eliminates bypassing of surplus oil, decreases heating and reduces horse-power requirements. Rated for pressures up to 1000 pounds per square inch.

Successfully applied and proven highly satisfactory on such applications as:

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A variety of valves and controls are available for standard operations

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SPECIAL ROLLED SECTIONS in mind

IN designing parts to be turned out on a quantity-production basis, it is well worth while to view them in the light of bar-mill capabilities. Often it happens that the design can be adapted to manufacture from special rolled sections.

Bethlehem pioneered this type of steel product and has rolled a wide variety of difficult sections. If a section can possibly be rolled, it can be rolled in the Bethlehem Bar Mills.

So great are the savings sometimes realized by the use of special rolled sections that we suggest a careful review of the parts of your product with an eye to this economical method of manufacture.

BETHLEHEM STEEL

Bethlehem Steel Company
General Offices: Bethlehem, Pa.

Bethlehem District Offices are located at Albany, Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas Detroit, Honolulu, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, New York, Philadelphia, Pittsburgh, Portland, Ore., Salt Lake City, San Antonio, San Francisco, St. Louis, St. Paul, Seattle, Syracuse, Washington, Wilkes-Barre, York. *Export Distributor:* Bethlehem Steel Export Corporation, New York it pays!

to keep metal working machines operating at their greatest efficiency . . . and one of the best guarantees of uninterrupted operation is Roper Pump equipment. Dependable since 1857.
Roper Non-Pulsating Coolant Pumps handle cutting compounds and lubricating fluids with ample power to supply the deepest bores and cuts. Guaranteed not to lose prime . . . high or low pressure, delivering 1 to 20 G.P.M.

ROPER

Write for all the facts in Bulletin No. R4MD

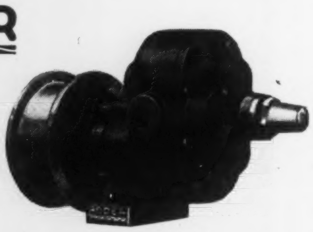

Figure 1850

Geo. D. Roper Corp., Rockford, Ill.

A LAMINATED PHENOLIC

OHMOID

Does the design call for a laminated phenolic material of high insulating properties? Great mechanical strength? Resistance to hot or cold water, oil and grease? Extreme lightness? Neat, perfectly smooth surface finish? Ready machinability?

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OHMOID is furnished in sheets, rods and tubes . . . in paper, linen and canvas grades . . . or in finished parts, fabricated to your specifications in our own completely equipped plant. May we send you details? There is no obligation.

WILMINGTON FIBRE SPECIALTY COMPANY
MANUFACTURERS OF GENUINE VULCANIZED FIBRE
WILMINGTON, DELAWARE

charge of the Chicago organization. Mr. Doan has served 18 years with Dow Chemical Co., 13 years as manager of its St. Louis office. With Mr. Doan will be K. M. Wildes, who has been associated with the company for eight years, five years in its St. Louis office and the last three years at Midland, Mich.

* * *

Emerson Electric Mfg. Co., St. Louis, has announced the removal of its general offices to 1824 Washington avenue, of the same city.

* * *

William Trudgian, formerly manager of the Denver office of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been made a special representative, handling duties previously taken care of by L. M. Cargo, retired.

* * *

Michigan Leather Packing Co. has moved into its new plant located at 6301 East Lafayette avenue, Detroit. Manufacturing space of the new plant, according to the announcement, has been increased a little more than 100 per cent.

* * *

Arch Warner has been named Michigan district manager of Logan Gear Co. and Bingham Stamping & Tool Co., with offices at New Center building, Detroit. Mr. Warner was for many years engineer and sales manager of Universal Products Co. Inc.

* * *

A. N. Murdock has been promoted to assistant sales manager of the Boston office of the American Steel & Wire Co., with headquarters in the Statler office building. Mr. Murdock has been associated for many years with the Providence, R. I., office of the company.

* * *

Harold Byron Smith has been appointed president of Shakeproof Lock Washer Co., Chicago, to succeed his father, the late Harold C. Smith. Other appointments are: Frank W. England and Carl G. Olson, vice presidents; Calmer L. Johnson, secretary and treasurer and Frank W. England, assistant secretary.

* * *

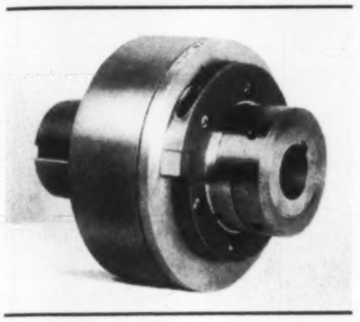
Belden Mfg. Co., 4689 West Van Buren street, Chicago, is increasing manufacturing facilities in both Chicago and Richmond, Ind., plants. The Chicago project, recently completed, consists of a new building which adds approximately 20,000 square feet of floor space, while at Richmond, Ind., an expansion of some 35,000 square feet of floor space is being made.

* * *

Martin L. Hopkins has been appointed assistant manager of sales of the bolt and nut division of Republic Steel Corp., Cleveland. Mr. Hopkins joined the Union Rolling Mill Co. in 1890 as secretary, and continued in this capacity after the merger of this company with Upson Nut Co. and Bourne-Fuller Co. in 1920, and until the formation of Republic Steel Corp. in 1930. Frank P. McEwen will continue as the other assistant in this division.

for intermittent drives . . . .

HILLIARD SINGLE REVOLUTION CLUTCH



THIS intermittent drive clutch will engage or release on each or any number of revolutions. It operates with precision—no slip—a means to perfect timing.

For cutting stock to extremely accurate lengths, the HILLIARD SINGLE REVOLUTION CLUTCH will improve the product of your machine whether it processes paper or steel. Clutch control may be made by an automatic stop actuated by the machine itself.

Available in capacities from 1/8 to 220 H.P. @ 100 R.P.M., this clutch is ideal in both design and range for application to most modern equipment.

Write for Bulletin 102-D.

Permit our specializing experience of thirty years to select the best clutch adaptable to your needs.

Clutches for Every Purpose

THE HILLIARD CORPORATION
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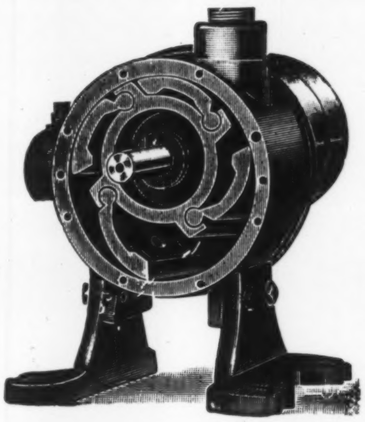
FRICTION—OVER-RUNNING—SINGLE REVOLUTION—SLIP—CENTRIFUGAL

QUIET, POWERFUL and EFFICIENT
LEIMAN BROS. PATENT ROTARY POSITIVE
AIR PUMPS

USED BY THE WORLD'S LEADERS AS STANDARD EQUIPMENT ON ALL SORTS OF AUTOMATIC MACHINES AND DEVICES

MANY SIZES and STYLES



TAKE UP THEIR OWN WEAR
No packing or tips on the wings

The built-in one-year-lubrication of Leiman Bros. Rotary Positive Air Pumps is the new wool yarn packed bearing which holds in suspension enough lubricating oil for one year's service — strained and purified.

The continuous unbroken cylinder surface makes these always noiseless air and gas pumps doubly quiet. The air enters and emerges in a sidewise course through the bypass in the cylinder head side.

This means a smooth, glassy-like cylinder surface, easy operation and saving in power.

The advantage gained by this simple construction is that the wings in constant operation will wear in conformity with the inner cylinder wall and become smooth and glassy like as well as case hardened in use, and maintain a perfect fit and positive air pressure, even after long continued usage.

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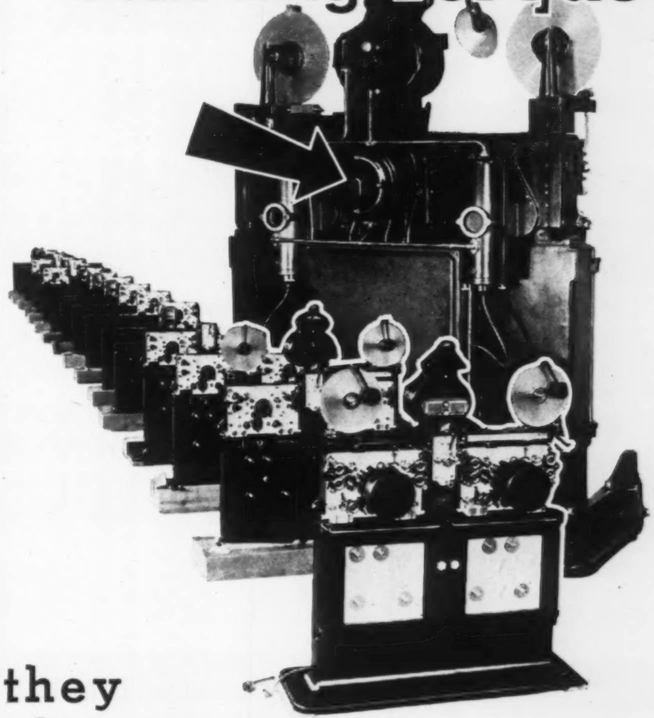
LEIMAN BROS., N. Y. Corp., 23 (P12) Walker St., New York City
Makers of good machinery for over 45 years

Bell & Howell wanted . . .

Reliability—Starting Torque



they chose—
BODINE Motors

The new Bell & Howell automatic printer for sound and pictures is used in the world's largest motion picture studios. For such an important machine, only the best equipment would do. In choosing a motor, Bell & Howell wanted high starting torque and utmost reliability. Efficiency was important, too. A three-phase induction motor was developed by Bodine engineers that exactly suited these requirements.

For over 30 years, Bodine engineers have been "tailoring" special fractional horsepower motors for just such unusual and exacting jobs. They will be glad to help solve your motor drive problems. Write Bodine Electric Co., 2258 W. Ohio Street, Chicago, Illinois.

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FRACTIONAL H. P.
MOTORS
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30,000 MILES OF SERVICE
48,000,000 COMPRESSIONS
VARIATION FROM ORIGINAL LENGTH 1/64"

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Spring performance like this is only made possible by a thorough knowledge of materials, temper and sound engineering methods. Your spring orders, too, will receive correspondingly good treatment if you send them to

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Believe It Or Not·· (with apologies to RIPLEY)

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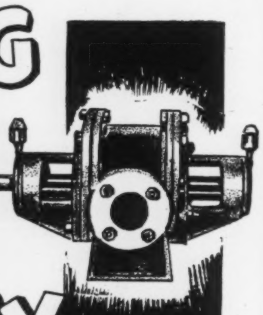
IDLER DRIVE,
BRONZE FITTED
ROTARY PUMP··



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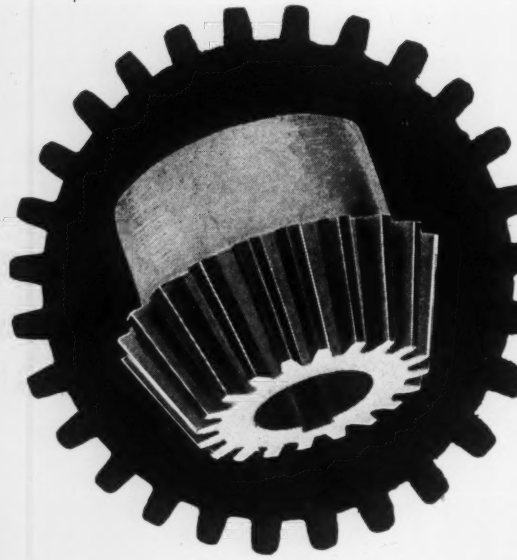

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Any type of Formica gear will run more quietly than a similar gear in metal, and if the dimensions are right will give equally long service . . . Noisy machinery is no advantage to anybody. It is harder to sell, and harder to use. The uproar exhausts the nerves of the workman and results in more mistakes and spoiled material . . . That is why Formica gears get steadily more popular with those who build machinery for sale, and those whose job it is to maintain it and get the most production from it . . . Good gear cutters everywhere are prepared to make prompt delivery on one or many Formica gears.

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Chicago, Ill.

Perfection Gear Company
Chicago, Ill.

Gear Specialties Inc.
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Foote Gear Works
Cicero, Ill.

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Worcester, Mass.

Massachusetts Gear & Tool
Co., Woburn, Mass.

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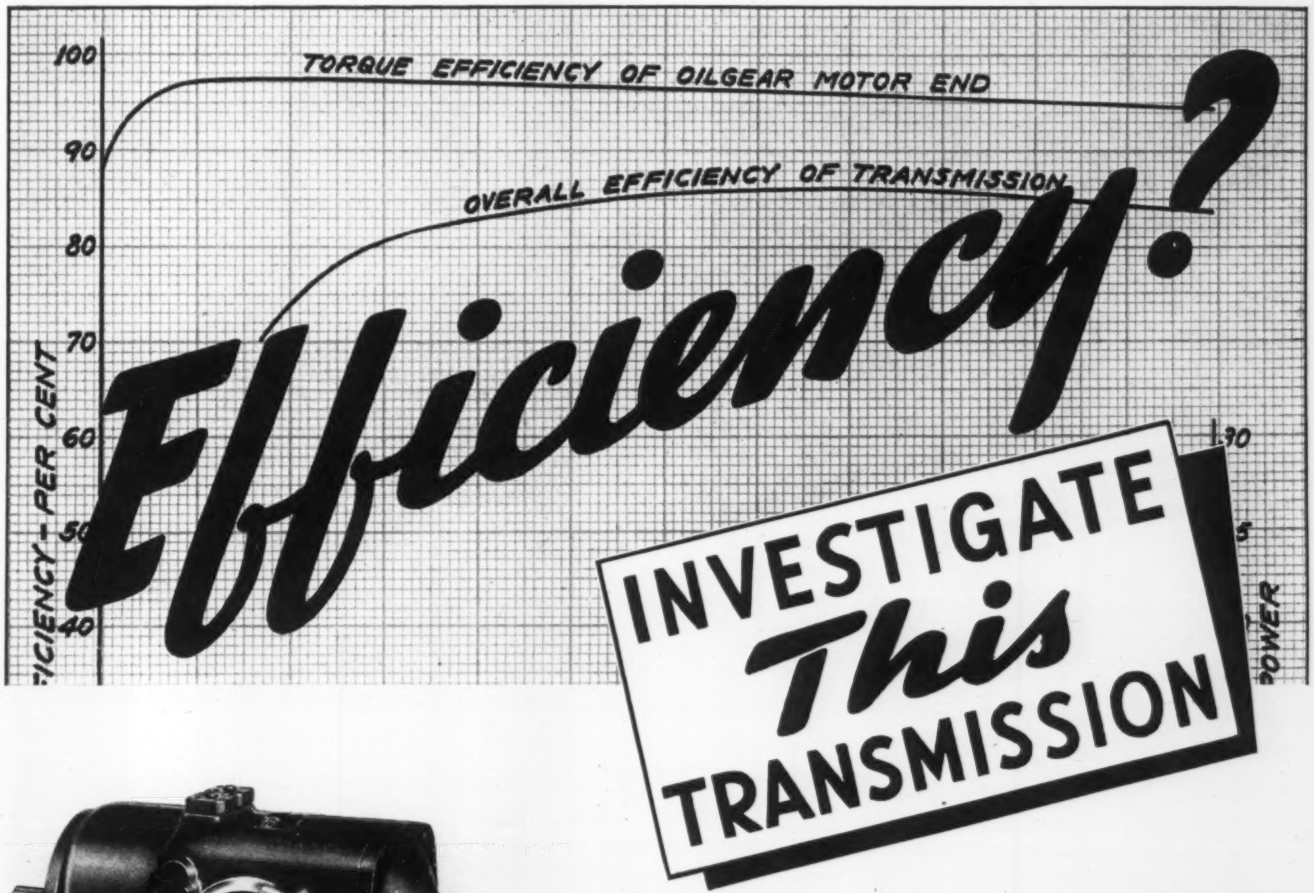

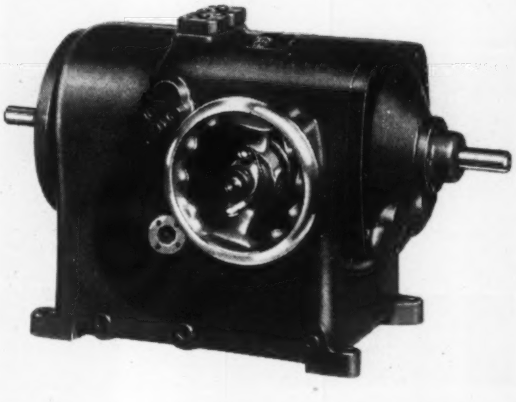

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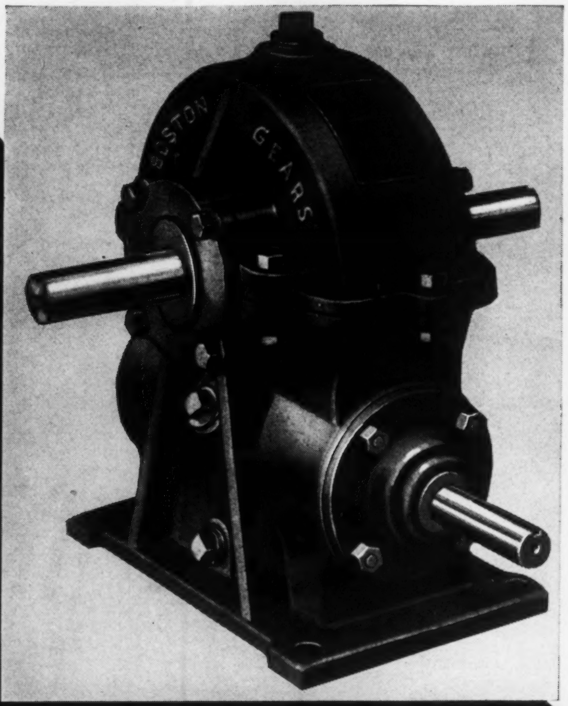
VARIABLE SPEED TRANSMISSIONS

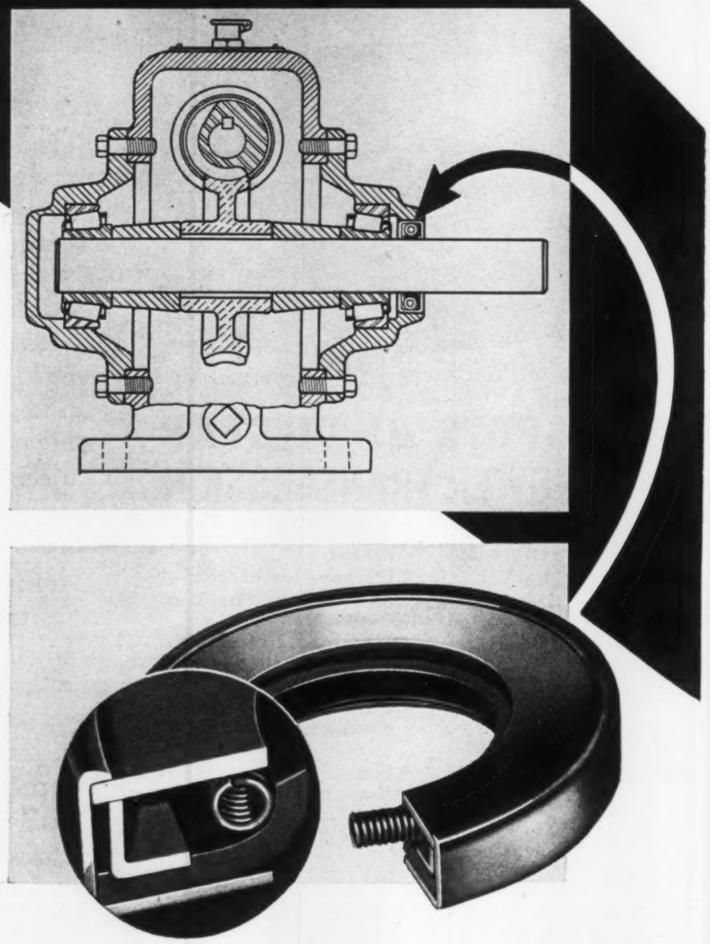
No lubricant loss tolerated



THE Boston Gear Works, Inc., in their worm gear Speed Reducer, have taken every precaution to assure the user long satisfactory service. Recognizing that the life of a speed reducer depends entirely on the proper operation of its bearings and gears, this company uses the most effective means to prevent loss of lubricant and contamination.

Chicago Rawhide "Perfect" Oil Retainers are used in the bearing housings of both high and low speed shafts. Thus no lubricant can escape at either point and no dust, moisture or foreign matter can enter the housings. Hazardous oil drip is eliminated.

This is only one of the thousands of applications of "Perfect" Oil Retainers to industrial equipment of all kinds. If your equipment is not so protected write for suggestions.



PERFECT Oil Retainer

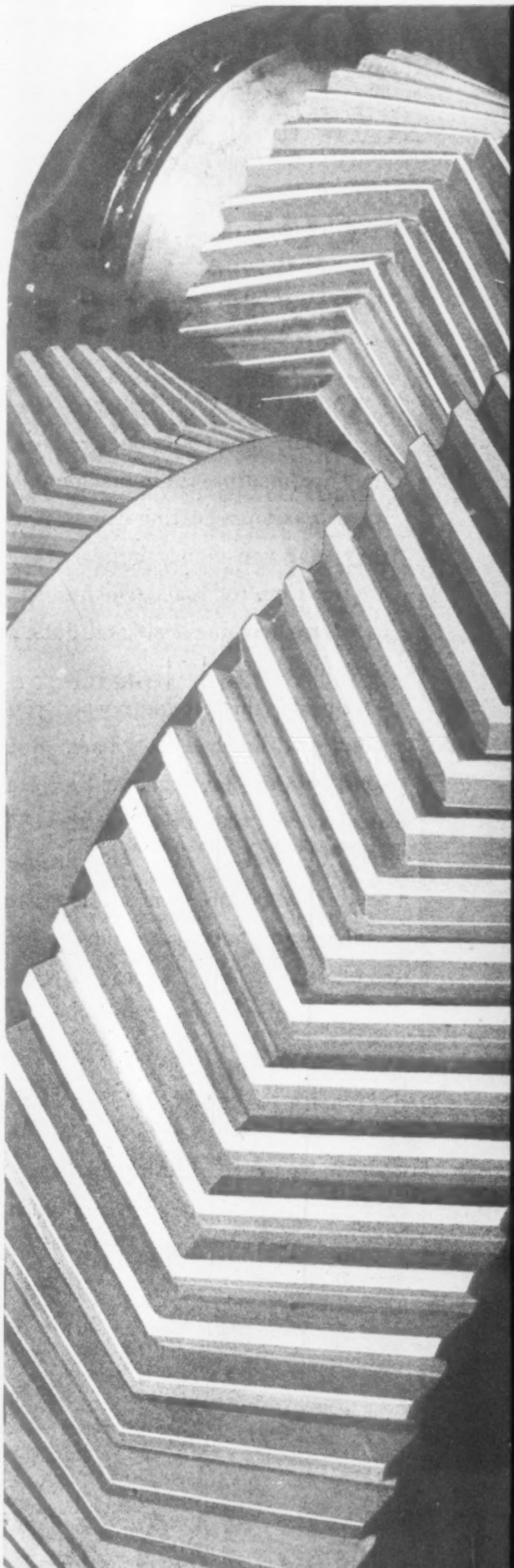
PATENTED

CHICAGO RAWHIDE MANUFACTURING COMPANY

1304 ELSTON AVENUE • CHICAGO, ILLINOIS

57 Years Manufacturing Quality Mechanical Leather Goods Exclusively

PHILADELPHIA CLEVELAND NEW YORK DETROIT BOSTON PITTSBURGH CINCINNATI

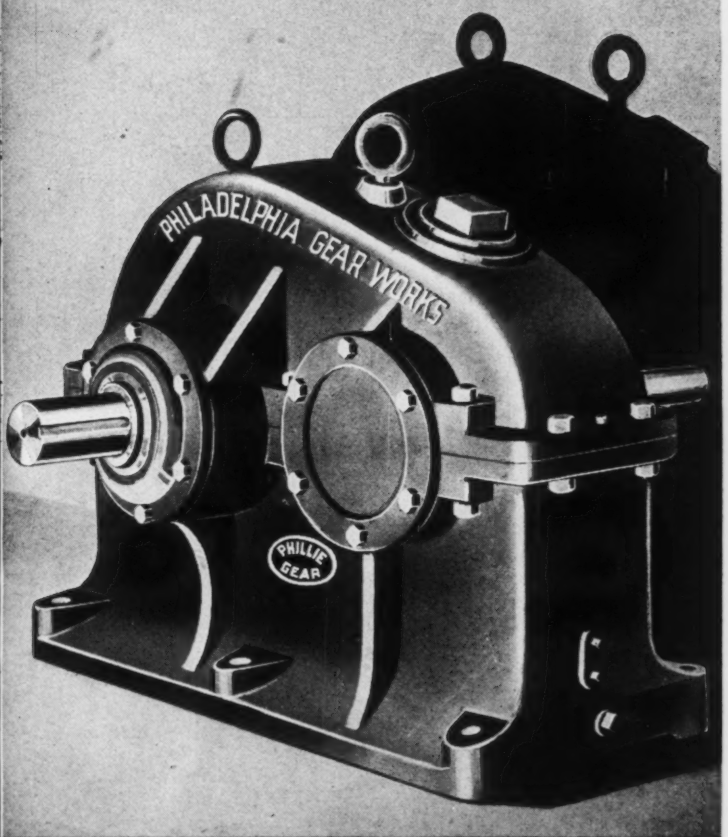


CUSTOM BUILT

- As a unit of a standard line, the Philadelphia Herringbone Gear Speed Reducer cannot be excelled. Its superiority of design and workmanship reaches the heights of custom built quality ... yet every part is standard -- readily, quickly replaceable.

Of the hundreds of units passing through the shop, the majority may look alike, yet each unit is handled as a special assignment. It has built into it the specific service characteristics that will deliver the required power with maximum efficiency, economy, durability and minimum maintenance.

Resolved to practical terms, the Philadelphia Herringbone Gear Speed Reducer may well be classed as your own creation, handled by master craftsmen, to do your job exactly as you want it done.



PHILADELPHIA *Speed Reducers*

HERRINGBONE TYPE

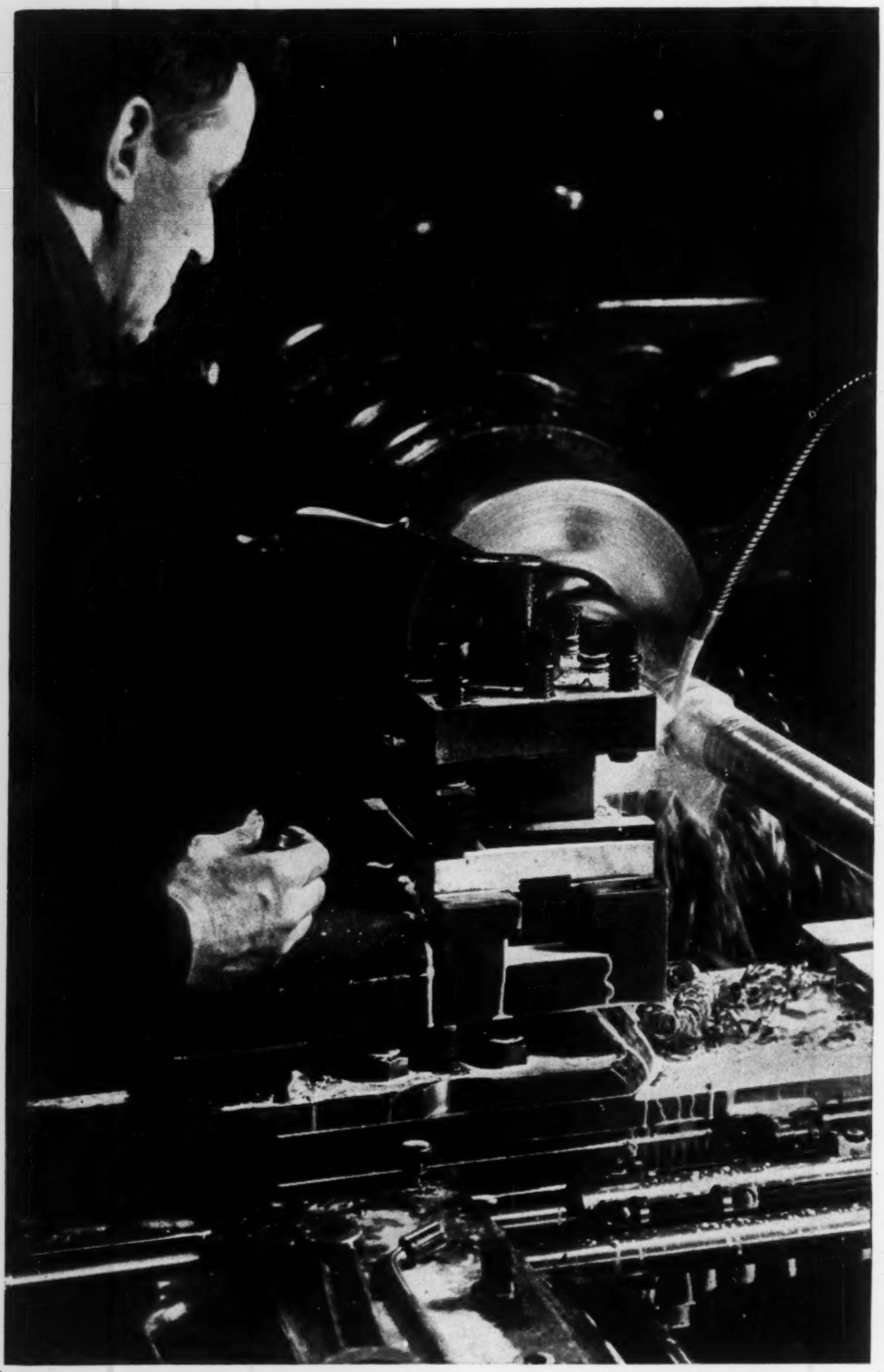
PHILADELPHIA GEAR WORKS

Main Office and Plant: G St., and Erie Ave., Phila., Pa.

Sales and Eng. Offices: New York City, Pittsburgh and All Principal Cities

THE RIGHT *Steel Bars*

CUT TOOL EXPENSE



AMERCUT Cold Finished Steel Bars save you money because they are unsurpassed in machinability at maximum cutting speeds. And they save you money because they are free from roll scale, which causes excessive machine wear and dulls a tool quickly.

Consider this economy when you select cold finished steel bars. But consider also that Amercut Bars are available in the correct grade and type of steel to meet the precise need of every job—and in the exact analysis and finish required.

Important too, is the fact that you can always count on prompt service—for we carry large and complete stocks of Amercut Cold Finished Steel Bars. And don't hesitate to ask us for technical assistance—our engineers are always available.

US
AMERCUT
COLD FINISHED
STEEL BARS
made by
AMERICAN STEEL & WIRE COMPANY

AMERCUT *Cold Finished* STEEL BARS

American Steel & Wire Company, 208 S. La Salle St., Chicago
Empire State Bldg., New York. Offices in all principal cities

US STEEL

Columbia Steel Co., San Francisco, Pacific Coast Distributors
United States Steel Products Co., New York, Export Distributors

UNITED STATES STEEL

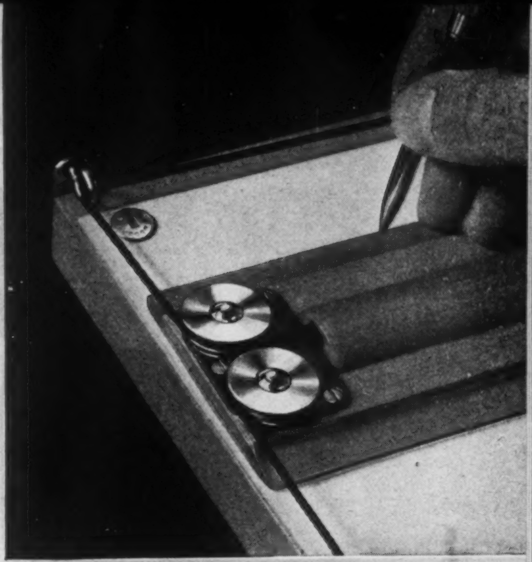
A Spectacular Success

TREMENDOUS DEMAND PROVES INSTANT APPEAL OF THIS PRECISION-BUILT RULING ATTACHMENT

Since its introduction a few weeks ago, the Dietzgen "Premier" Parallel Ruling Attachment has established sales records. Everyone instantly appreciates its outstanding advantages . . . features never obtainable before in *any* parallel ruling attachment. As shown in the photograph below, there are no exposed cords over the work area when you use a Dietzgen "Premier" . . . the cross-over paralleling cords are carried through a reinforcing channel—out of the way. And this reinforced construction means a *flat* straight-edge that *stays* flat on your work. You'll like the many other features of the Dietzgen "Premier," its smoother operation, its bump-proof fastening, its better appearance, etc. Write for illustrated circular or call your Dietzgen representative for a demonstration.

EUGENE DIETZGEN CO.

Chicago • New York • New Orleans • Pittsburgh • San Francisco
Milwaukee • Los Angeles • Philadelphia • Washington



UNRESTRICTED WORKING AREA

Despite complete elimination of overhanging parts, the Dietzgen "Premier" Parallel Ruling Attachment has no "dead" spots. The entire board from top to bottom and side to side is open working area when you use the Dietzgen "Premier."

The enclosed channel construction not only keeps the cords out of the way, but provides rigid reinforcement for the straight-edge that keeps it flat on your work. You will also be amazed at the comfort and convenience it provides, a straight-edge you can push or pull either way without "thumbing" or smudging your work. Note also that the "Premier" need not extend the full length of your board. May be had in any desired length on special order. Standard lengths are 18 in., 24 in., 30 in., 36 in., 42 in., 48 in., 54 in., 60 in., 72 in., 84 in., 96 in.

DIETZGEN

"PREMIER" PARALLEL RULING ATTACHMENT

ONE *sure* WAY
TO IMPROVE YOUR PRODUCT

GET MORE *Power Hours* WITH DUMORE MOTOR PARTS

Whether it be one unit or ten thousand, Dumore motors and parts undergo not only a *five-time inspection* in manufacture but also an engineering inspection.

Armatures are *dynamically balanced* by special Dumore process while running at high speeds—not just slowly rotating. That's why they are vibrationless, even after years of service.

Ever hear of "centrifugal breathing?" There's none of it in Dumore motors because the armature windings are fully expanded at high speed—then sealed.

You can be sure of *longer* brush life because Dumore grinds the commutators concentric with the bearings. Another reason why, with Dumore motors, you can install 'em and forget 'em.

Forced ventilation assures cool running in continuous operation . . . yet this feature doesn't add to the size of Dumore motors. Special housings and material where needed to resist moisture, acid, fumes, etc.

Another hidden quality . . . armature leads are swaged by special Dumore process forming a 100% electrical contact. No possibility of ever working loose.

Every Dumore motor is actually run-in to seat the brushes. No commutator "fireworks"—no pitting of the commutator—no waste of power.

Now . . . get fractional h. p. universal motor parts "tailor-made" to fit your product . . . at a *saving* instead of a premium. Get the benefit of 23 years' experience that Dumore's staff of engineers have had in designing motors and adapting them to power problems peculiar to highly specialized machinery and tools. Get the extra "power hours" built into every Dumore motor through precision manufacturing methods and practices.

Dumore makes a complete line of series universal motors . . . 1/600 to 3/4 h. p. . . . to operate on alternating or direct current, 0 to 60 cycles . . . motors which, because of their unusually smooth, dependable power, are the ideal drive for thousands of applications.

What is your problem? Regardless . . let Dumore engineers help you solve it. Write for the new Dumore catalog which will be accompanied by an engineering service application blank.

THE DUMORE CO.
Dept. 126-M
Racine, Wis.

Send me the new Dumore Motor Catalog and Engineering Service Application Blank.

Name________________________
Firm Name________________________
Address________________________
City____________ State____________

● TYPICAL USERS OF DUMORE MOTORS AND PARTS

The Ampro Corporation, Chicago; Exhibit Supply Co., Chicago; Challenge Machinery Co., Grand Haven, Mich.; R. C. A. Mfg. Co., Camden, N. J.; K. O. Lee & Son Co., Aberdeen; Central Dental Manufacturing Co., Louisville; Treatment Regulator Corp., Detroit; Beach Aircraft Co., Wichita.

DUMORE
FRACTIONAL HORSEPOWER
MOTORS

MANY USERS *Know*...
MORE ARE DISCOVERING—

THE PRACTICAL ADVANTAGES OF SHAFER ROLLER BEARINGS . . . . .

Shafer self-aligning Roller Bearings are proving their unique ability day by day in the widest range of industrial uses. Their free-rolling, load-carrying ability stops power waste; their dependable reserve capacity prevents service interruptions and minimizes maintenance; and their performance is unchanged by severe operating conditions. Simple installation and remarkably long life mean worthwhile economy.

Only the Shafer CONCAVE roller design combines in one simple bearing:

1. Roller bearing capacity for radial, or thrust loads, or any combination of radial-thrust loads.
2. Self-alignment within the bearing itself.
3. Simple adjustability.

Only Shafer offers the full measure of long-lived, trouble-free service in a bearing so simply installed, so readily adapted to industrial uses.

Available in a full range of sizes—Pillow Blocks, Flange Units, Cartridge Units, Take-up Units, Duplex Units, Hanger Boxes, Conveyor Rolls, Radial-thrust Roller Bearings. Write for Catalog 12-A.

SHAFER BEARING CORPORATION
35 East Wacker Drive, Room 2822, Chicago, Ill.

SHAFER

Everything you need in a Roller Bearing

Pillow Block

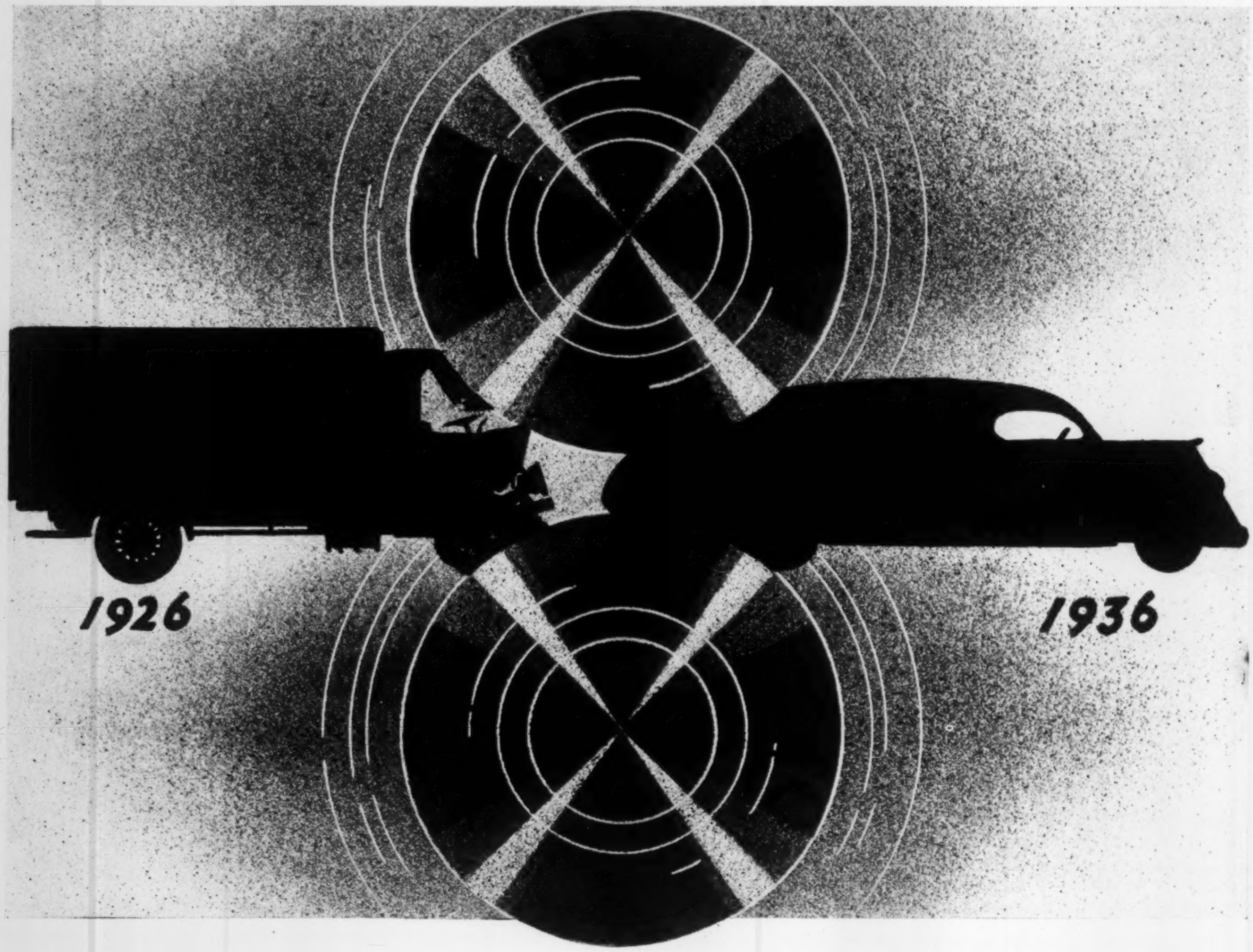
Flange Unit

Take-up Unit

Hanger Box

Cartridge Unit

Duplex Unit



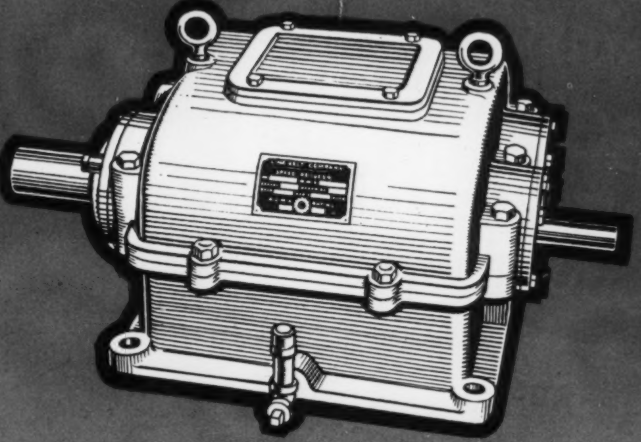
Squeeze the Deadweight

from machinery of every kind

Compare this year's truck with its predecessor of ten years ago. Its weight, price and cost of operation have been radically reduced, with no impairment of safety. In fact it is more dependable, more enduring than ever before. Among the materials that have played an important role in this striking transformation are the Nickel Alloy Steels. Through a partnership with Nickel, the simple steels of yesterday have been rendered tougher and stronger — more highly resistant to shock, stress, fatigue, abrasion and wear. Their greater strength-to-weight ratio offers every manufacturer the opportunity to cut down power consumption and replacement costs. Our experience in the application of Nickel to industrial problems is at your disposal. Send for List "A" of available publications on Nickel and its alloys.

Nickel Alloy Steels

THE INTERNATIONAL NICKEL COMPANY, INC., NEW YORK, N. Y.



LINK-BELT
HERRINGBONE GEAR
REDUCER

● A fully enclosed, compact, self-contained speed reducer built in a variety of sizes, in single, double and triple reductions, in a large range of ratios and horse powers. Ability to withstand shock loads, and conservation of space, are outstanding qualities of this unit. Send for Book No. 1519. Address Link - Belt Company, Philadelphia, Indianapolis, Chicago, San Francisco, Atlanta, Toronto, or any of our offices located in principal cities.

5874

THE SYMBOL OF QUALITY
LB
LINK-BELT

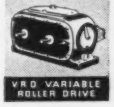
LINK-BELT POSITIVE DRIVES INCLUDE

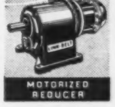
P.I.V. GEAR SPEED VARIATOR

ROLLER CHAIN DRIVE

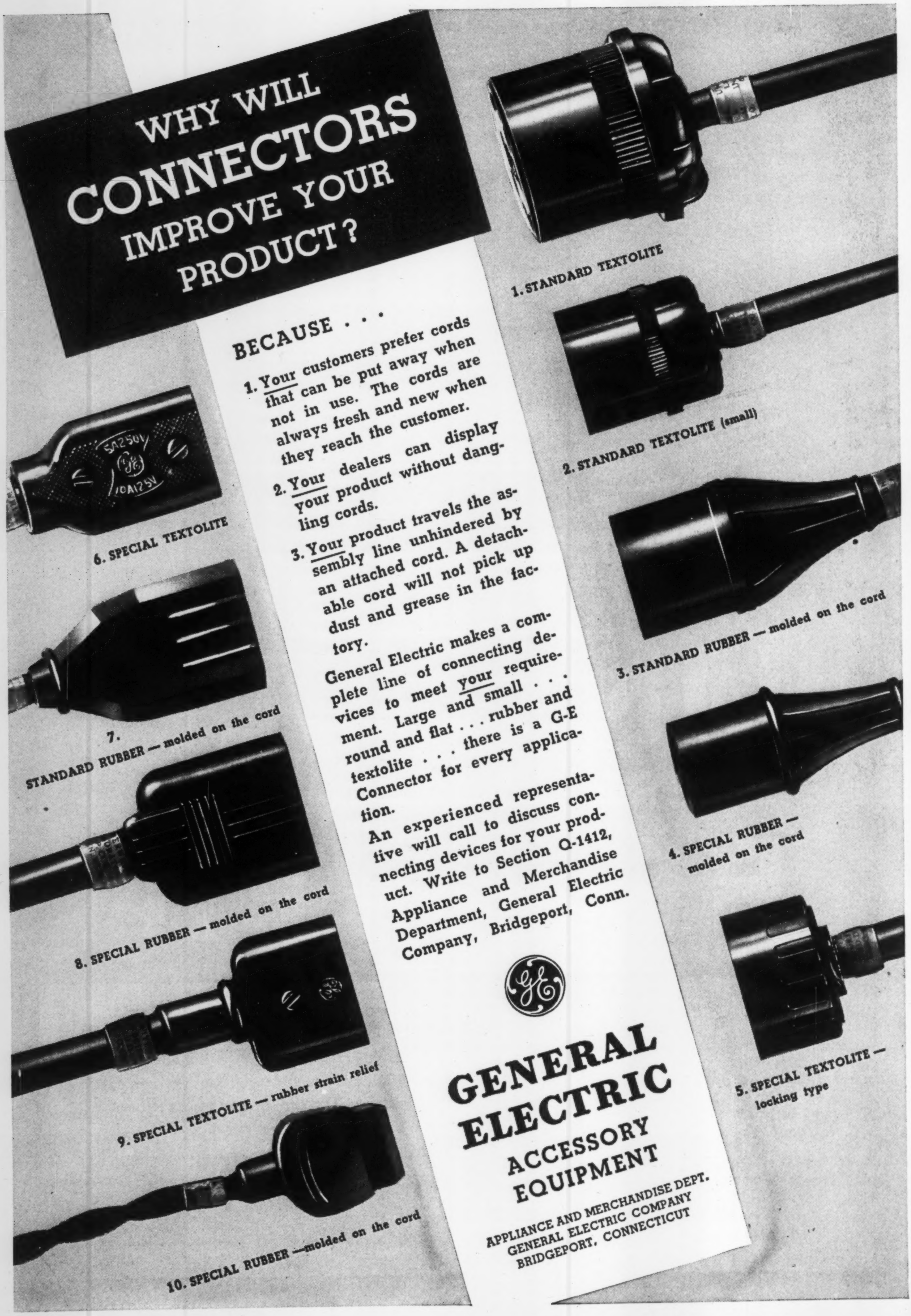
WORM GEAR REDUCER

HERRINGBONE GEAR REDUCER


V.R.D. VARIABLE ROLLER DRIVE


MOTORIZED REDUCER

SILENT CHAIN DRIVE



WHY WILL CONNECTORS IMPROVE YOUR PRODUCT?

BECAUSE . . .

1. Your customers prefer cords that can be put away when not in use. The cords are always fresh and new when they reach the customer.
2. Your dealers can display your product without dangling cords.
3. Your product travels the assembly line unhindered by an attached cord. A detachable cord will not pick up dust and grease in the factory.

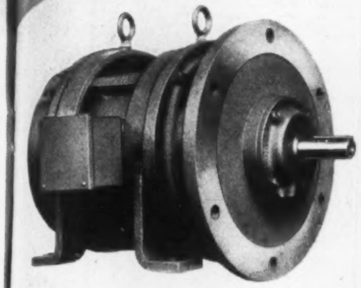
General Electric makes a complete line of connecting devices to meet your requirement. Large and small . . . round and flat . . . rubber and textolite . . . there is a G-E Connector for every application.

An experienced representative will call to discuss connecting devices for your product. Write to Section Q-1412, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

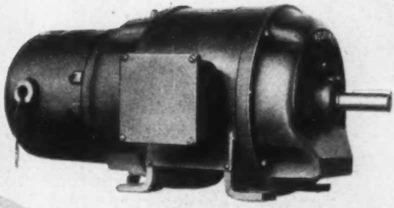
GENERAL ELECTRIC
ACCESSORY EQUIPMENT

APPLIANCE AND MERCHANDISE DEPT.
GENERAL ELECTRIC COMPANY
BRIDGEPORT, CONNECTICUT

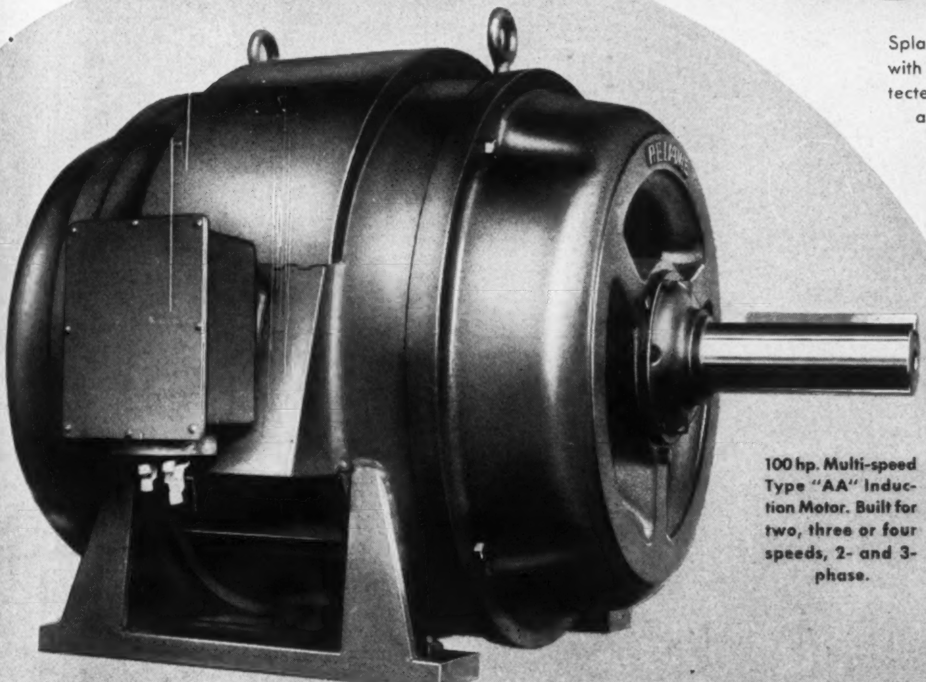
1. STANDARD TEXTOLITE
2. STANDARD TEXTOLITE (small)
3. STANDARD RUBBER — molded on the cord
4. SPECIAL RUBBER — molded on the cord
5. SPECIAL TEXTOLITE — locking type
6. SPECIAL TEXTOLITE
7. STANDARD RUBBER — molded on the cord
8. SPECIAL RUBBER — molded on the cord
9. SPECIAL TEXTOLITE — rubber strain relief
10. SPECIAL RUBBER — molded on the cord



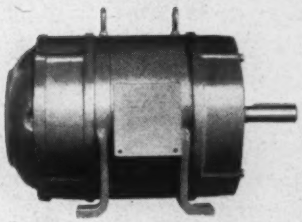
Flange-type squirrel-cage motor built with or without feet.



Splash-proof Type "AA" Motor with magnetic brake. Motor is protected against splashing liquids and dirt falling from above.



100 hp. Multi-speed Type "AA" Induction Motor. Built for two, three or four speeds, 2- and 3-phase.



Enclosed, fan-cooled motor designed for high starting torque, low starting current, normal slip. For loads such as mixers, large compressors and conveyors started under load.

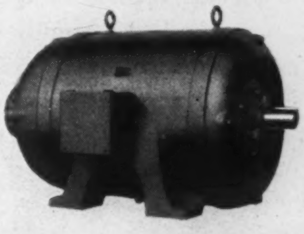
SPECIAL-PURPOSE A-c. SQUIRREL-CAGE RELIANCE MOTORS

RELIANCE Squirrel-cage Induction Motors are taking over more jobs every day. They are invading fields of application usually thought of as belonging strictly to direct-current or wound-rotor motors. They are also being supplied in such forms as to do some of their accustomed jobs better.

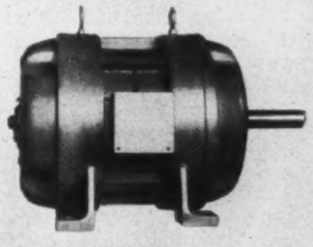
These improvements in form and operating characteristics are cutting down initial equipment costs, simplifying control and reducing maintenance. The ability to control speeds without gear changes; to start, reverse and stop quickly without clutches, is bringing definite betterments in production and quality in various industries.

Deciding when and how to take advantage of these advances involves special consideration of operating conditions and requirements. We shall be glad to tackle some case with you. There's no obligation in testing our ability to render you a helpful service.

RELIANCE ELECTRIC & ENGINEERING COMPANY
1088 IVANHOE ROAD CLEVELAND, OHIO
Branches: Boston, Buffalo, Chicago, Cincinnati, Detroit, Greenville, (S. C.), New York, Philadelphia, Pittsburgh. *Representatives in other principal cities*

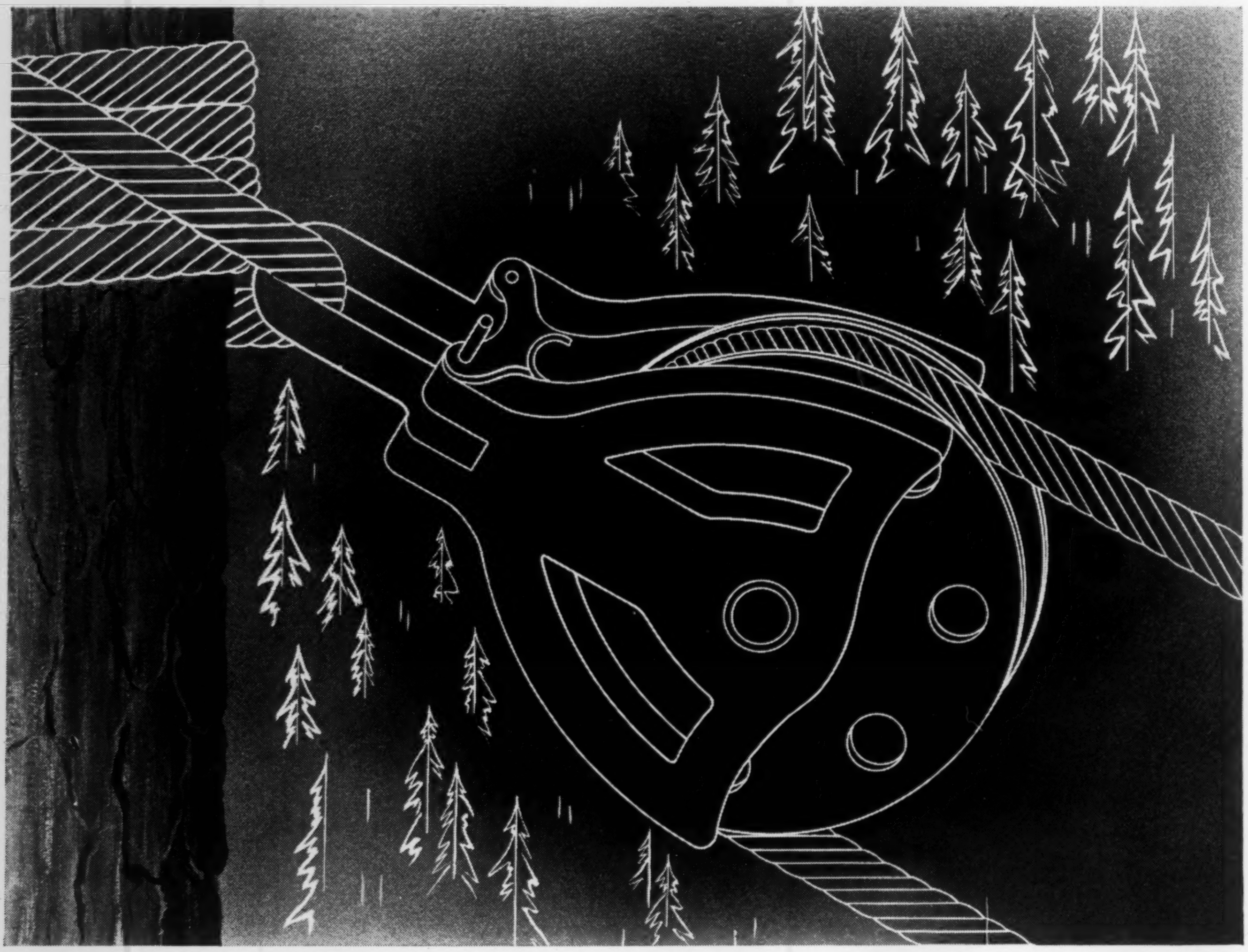


Low-inertia, special-torque fan-cooled motor designed for quick acceleration, quick stopping, frequent and rapid reversing.



Squirrel-cage motor for heavy presses and other flywheel applications. Has high starting torque, low starting current.

RELIANCE A-C D-C MOTORS



MOLY steel's greater strength means less weight—easier handling

WHEN operating equipment has to be handled by man-power, the importance of light weight through the use of the strongest possible material comes home with telling effect. Logging blocks, for example. Ask any rigger what a back-breaking job it is to tote them aloft. Think, too, of the abuse they get. . . . Dropped from great heights, battered and banged around, exposed to weather—it's a hard life they lead.

By making side frames and sheaves out of 2% Nickel-0.40% Moly steel, the weight of logging blocks can be reduced one-third to one-half—without sacrifice of strength. Similar foresight in the construction of other forms of industrial equipment can lead to corresponding savings in time, labor, wear, depreciation.

What do you make or use that would gain through lighter weight, higher strength, greater resistance to impact, abrasion, creep, corrosion? Look into Moly and its many-sided qualities for improving any steel or iron—whether plain or otherwise alloyed. Our helpful technical book, "Molybdenum," goes into the subject at considerable length. Yours for the asking—as is also our periodical news-sheet, "The Moly Matrix." If interested in some particular ferrous problem, our laboratory facilities are at your disposal.

CLIMAX MOLYBDENUM COMPANY, 500 FIFTH AVENUE, NEW YORK CITY

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

MOLY
Mo-lyb-den-um

CUTS COSTS
CREATES SALES

THESE TWO *CAN'T BE FOOLED*

WEAR
VIBRATION

NOTHING LESS THAN A SUFFICIENT RANGE OF *Live Action* CAN COMBAT THE FORCES OF WEAR AND VIBRATION . . .

Theories may sound good but it takes action . . . *Live Action* to keep machinery tight! No bolt or nut ever loosened *initially* from vibration or shock because it *turned backwards* upon its threads. The friction and adhesion in the threads is infinitely more than enough to resist backward turning due to vibration and shock so long as the *pressures* set up by the wrenching in the original assembly *are maintained.* Only a SPRING WASHER *can do this.*

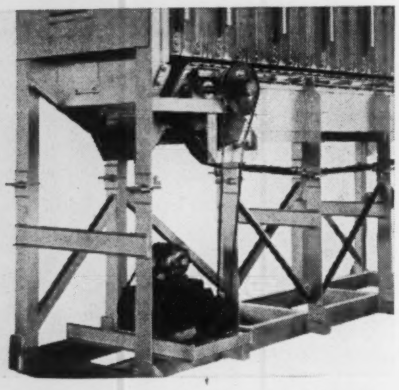
There is no substitute for a spring washer

SPRING WASHER INDUSTRY
616 WRIGLEY BUILDING, CHICAGO, ILL.

ONLY A SPRING WASHER HAS Live Action!

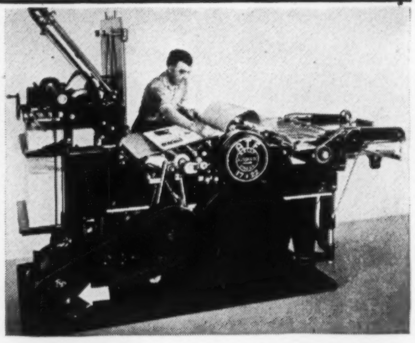
What's New
IN VARIABLE SPEED CONTROL

ON FURNACE



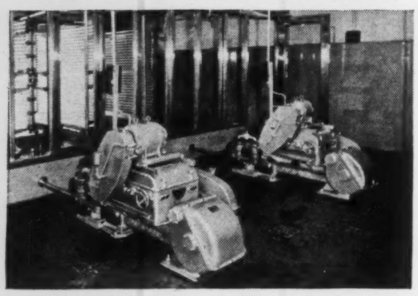
This Surface Combustion forging furnace is used to heat ends of motor valve rods. A fixed furnace conveyor speed is inadequate because of different sizes of rods, variances in composition or hardness of metal and fluctuating production schedules. . . . The REEVES Variable Speed Transmission varies conveyor speeds, through the 10 feet of heating chamber, from ½ foot to 2 feet per minute. Result: correct heating time for each rod; perfect production timing; no lost motion.

ON NEW 17x22-KELLY PRESS



Because many variables enter into the production of good press work, American Type Founders provide the REEVES Vari-Speed Motor Pulley as standard equipment on their new Kelly Press. Merely by turning a convenient speed control handwheel, the pressman secures any press speed desired. Not "steps" or "jumps" in speed, but smooth gradations between fast and slow, securing *exactly* the proper speed for each class of work. This REEVES unit is applied directly to shaft of any constant speed motor and forms direct drive to machine.

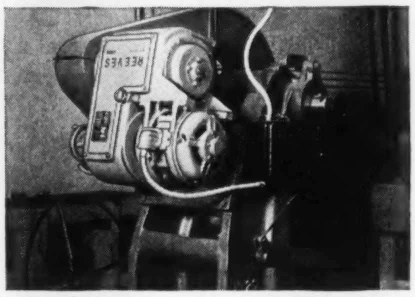
ON MILK PUMPS



M. T. Davidson Co. meets variable speed requirements of sanitary milk pumps by standardizing on the REEVES Horizontal Enclosed Design Transmission. These pumps are used for delivering raw milk from receiving platform to cold storage tanks; also in pasteurizing and bottling operations. Through REEVES regulation, the quantity of milk delivered can be varied according to size of bottles and according to day-to-day capacity of the plant.

Some machinery builders delay in equipping for complete speed flexibility because they think it involves elaborate re-designing. As a matter of fact, REEVES Speed Control, now adopted by builders of 1,150 different machines, is available in such an extensive range of designs that it is readily incorporated on nearly any type of machine. Make variable speed control an important consideration *now*—and let REEVES engineers tell you how easily an application can be made to meet your individual needs *correctly*.

ON PUNCH PRESS



Here is a standard equipment application of the REEVES Vari-Speed Motodrive—newest member of REEVES line—to a Bliss punch press. Output speeds are infinitely adjustable from 387 r. p. m. to 1547 r. p. m. providing exactly the right speed required for each gauge of metal used, size and shape of product, etc. The Motodrive combines in one compact enclosure a constant speed motor, variable speed mechanism, and reduction gears where desired.

★ MODERN
★ ACCURATE
★ TIME-TESTED

REEVES
SPEED CONTROL

REEVES PULLEY CO., Columbus, Indiana

Without obligation, please send copy of ( ) 112-page Speed Control Handbook; ( ) Vari-Speed Motor Pulley Catalog, V-100; ( ) Motodrive Bulletin, M-363. **H-126**

Name ....

Company ....

Address ....

Engineering
Library

December 1936

MACHINE DESIGN

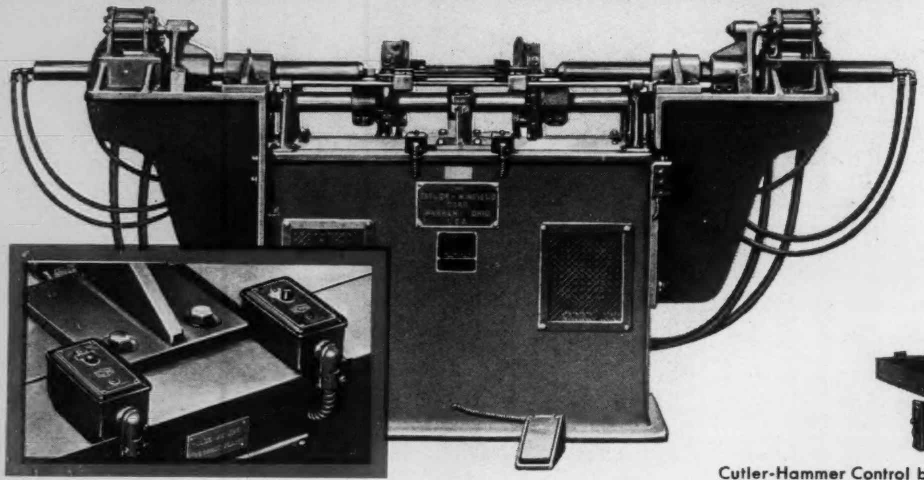
as it affects

ENGINEERING
PRODUCTION
SALES

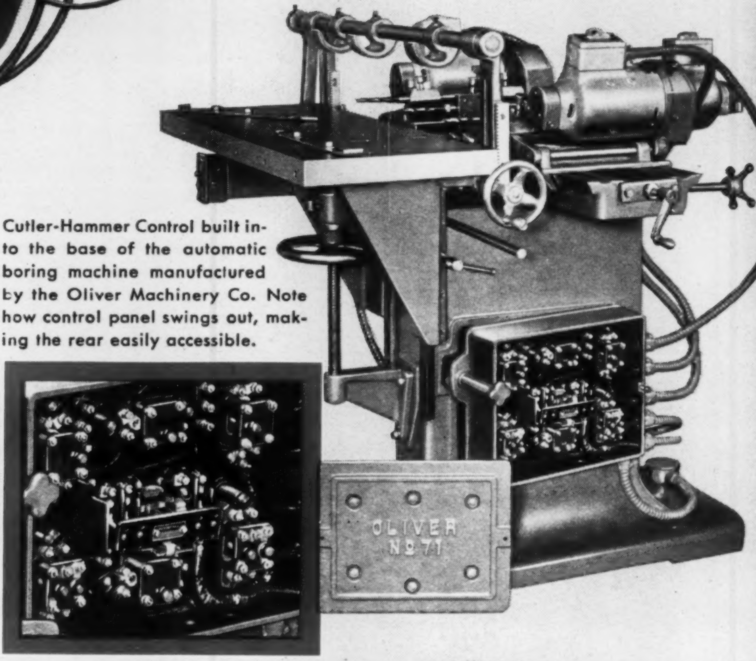
Parts . . . . Materials . . . . Methods . . . . Finishes

An ALL-REVEALING *Insignia*

CUTLER-HAMMER
MOTOR CONTROL
C-H



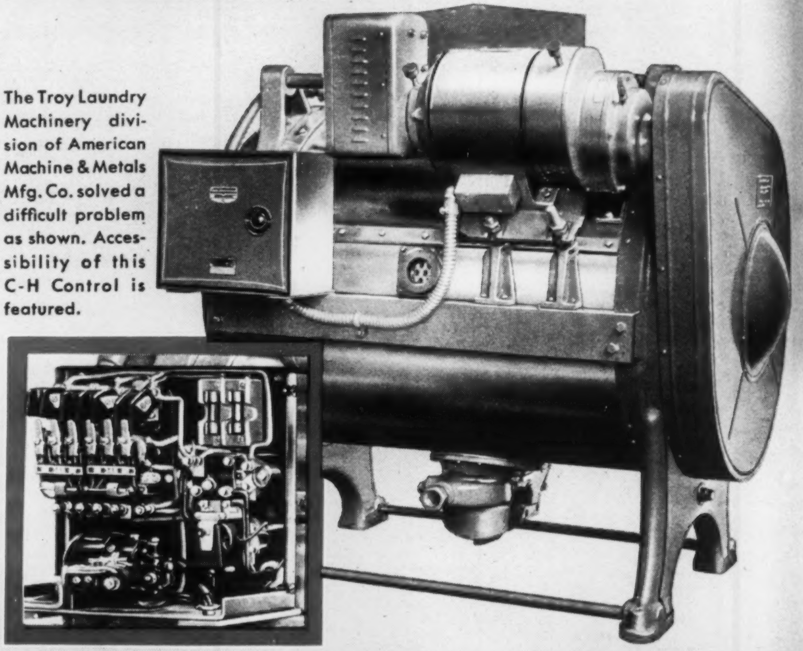
The completely automatic, butt welder of the Taylor-Winfield Corp., has its Cutler-Hammer Control in the base. Push-button stations may be located wherever desired, in this case convenient to the work.



Cutler-Hammer Control built into the base of the automatic boring machine manufactured by the Oliver Machinery Co. Note how control panel swings out, making the rear easily accessible.

THAT a machine has "built-in" motor control tells many things. It is an indication of the modernness of the machine . . . that the machine is *completed*, ready to go . . . that it is provided with the control exactly fitting it. Built-in control helps to better appearance, makes for compactness, uniformity.

But, even more revealing . . . the Cutler-Hammer emblem on the built-in control. Insignia of the one name outstandingly associated with Motor Control, mark of the 43 years of Cutler-Hammer's unparalleled pioneering and success, it indicates that the machine maker has spared no effort to make his product the finest of its type. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1310 St. Paul Ave., Milwaukee, Wis.



The Troy Laundry Machinery division of American Machine & Metals Mfg. Co. solved a difficult problem as shown. Accessibility of this C-H Control is featured.

CUTLER-HAMMER MOTOR CONTROL

STARTS ★ STOPS C-H REGULATES ★ PROTECTS

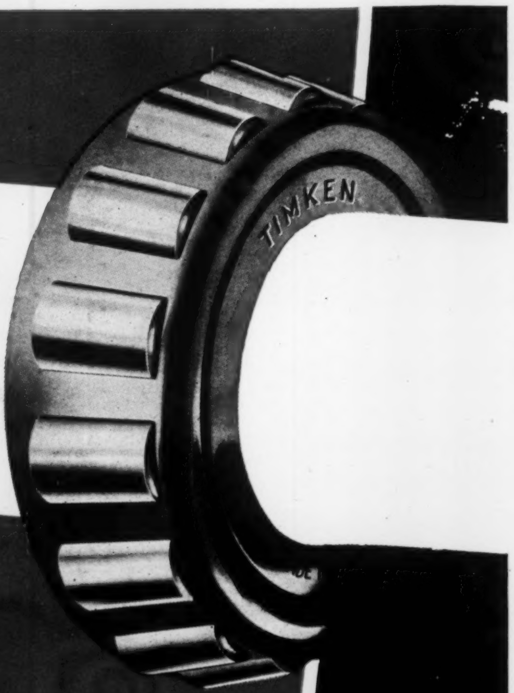
MASTER

builds the complete unit

- **INTEGRAL CONSTRUCTION**—In Master Geared Head Motors, both motors and gears are designed and built by one organization into a well balanced unit.
- **GUARANTEED AS A UNIT**—Undivided responsibility for the satisfactory operation of the entire unit.
- **GREATER FLEXIBILITY**—Master can readily modify either the motor or gear unit to fit exactly your individual requirements.
- **SIMPLIFIED DESIGN**—More compact—permanent alignment—longer, trouble-free operation.

THE MASTER ELECTRIC COMPANY, DAYTON, OHIO

MODERN SPINDLE PRECISION
is TIMKEN BEARING PRECISION

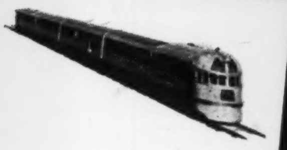


The extreme and constant precision demanded in modern machine tool performance is found in all types of heavy duty machines with Timken-equipped spindles.

Timken Bearings — *precisely preloaded* — meet every modern requirement with full and lasting efficiency. They combine velvety smoothness of operation with unyielding rigidity; reduce power consumption; hold radial, thrust and combined loads in check; and maintain their initial accuracy indefinitely.

You need all of these modern advantages on your spindles. To make sure of getting them specify Timken-equipped.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO



One of the 8 Burlington "Zephyr" Streamlined Trains Equipped with Timken Bearings.

TIMKEN TAPERED ROLLER BEARINGS